THE

FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL.

VOL. 30. Thursday, November 13, 1924. No. 430.

PUBLISHED WEEKLY.

Subscription Terms: 15s. per annum.
Foreign and Colonial, 17s. 6d. per annum.
All Subscriptions are payable in advance.

All communications to be addressed to the Editor, or to the Publisher, as the case may be, of

THE FOUNDRY TRADE JOURNAL,
BESSEMER HOUSE, 5, DUKE STREET, ADELPHI,
LONDON, W.C.2.

Contents.

	PAGE
Standardisation of Colliery Castings	409
German Method of Costing in Foundries	410
Birmingham and the Swedish Iron and Steel Industry about 1765	411
The Selling of Castings—III	412
The Grain Size Grading of Moulding Sand	413
Analysis of Grey Iron Foundry Alloys—IX	416
The Influence of Manganese on Cast Iron	417
Designs	419
Making Propellers—VI	420
Catalogues Received	421
American Foundrymen's Association	422
A New Junior Section for Foundrymen Formed	424
Inspection and Annealing	424
Institute of British Foundrymen	425
Company News	427
The New Parliament	427
Foundry Query	427
Trade Talk	428
Iron and Steel Markets	430

Forthcoming Events.

NOVEMBER 14.

Institute of Metals (Swansea Local Section):—Ordinary meeting at Swansea. "The Inner Structure of Alloys," Paper by W. Rosenhain.

Barrow and District Association of Engineers:—Ordinary meeting at Barrow. "The Determination of Hardness in Metals," Paper by A. H. Hird, B.Sc.

NOVEMBER 15.

Institute of British Foundrymen (Lancashire Branch, Junior Section):—Opening meeting of the new Junior Section. A Lecture on "Foundry Craft," by W. H. Sherburn.

Institute of British Foundrymen (Wales and Monmouth Branch):—Ordinary meeting at Cardiff. "The Manufacture of High Tensile Cast Irons," Paper by A. Marks.

NOVEMBER 19.

British Cast Iron Research Association:—Annual general meeting in London. The President, Lord Weir, will take the chair.

NOVEMBER 20.

Birmingham Metallurgical Society:—Ordinary meeting at Birmingham. "Steel Wire: Its Manufacture and Properties," Paper by E. W. Atkins.

Institution of Mining and Metallurgy:—Ordinary meeting in London.

Birmingham Metallurgical Society:—Ordinary meeting at Birmingham. "Steel Wire, its Manufacture and Properties," Paper by E. W. Atkins.

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN AND THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION.

Institute of British Foundrymen.
PRESIDENT, 1924-25, R. O. Patterson, Blaydon-on-Tyne.
LIST OF SECRETARIES—
General Secretary: W. G. Hollinworth, 38, Victoria Street, London, S.W.1.
Lancashire: T. Makemson, 21, Beresford Road, Gorse Hill, Stretford, Manchester.
Birmingham: H. James Roe, 33, Herbert Road, Bearwood, Birmingham.
Sheffield: R. Village, Albion Foundry, Whittington Moor, near Chesterfield.
Scottish. J. Bell, 60, St. Enoch Square, Glasgow.
London: H. G. Sommerfield, Charterhouse Chambers, Charterhouse Square, London, E.C.1.
Newcastle-on-Tyne: Colin Gresty, 93, Queen's Road, Monkseaton, Northumberland.
East Midlands: H. Bunting, 17, Marcus Street, Derby.
Coventry: J. M. Meston, Priory House, Priory Street.
West Riding of Yorkshire Branch: A. Love, 232, Gladstone Street, Bradford.
Wales and Monmouth Branch: J. J. McClelland, M.I.Mech.E., Druslyn, Bishops Road, Whitechurch, Glam.

Welsh Engineers' and Founders' Association.
Secretary: F. J. Griffiths, 20, Fisher Street, Swansea.

Standardisation of Colliery Castings.

The British Engineering Standards Association is busily engaged in propaganda work in the various coalfields with a view to engaging the interest and active support of colliery managers for the principle of the standardisation of colliery plant. The Mining Association of Great Britain has given its *imprimatur* to this movement, and has recommended the district coalowners' associations to form regional committees for the purpose of settling the standards most suitable for their local conditions.

It is scarcely necessary to emphasise the great benefit that would accrue to the coal industry and to the foundrymen if, and when, the present chaotic conditions pertaining to the equipment of the collieries should be reduced to some order, and the multiplication of patterns, many of them differing only in a very slight degree, brought to an end. Whilst we are well aware that there is a limit to which the principle of standardisation can be applied to colliery requisites, we feel sure that mine managers will agree that substantial economies could be effected and greater efficiency secured by the adoption of more uniformity in design for their castings.

On the first consideration of this question, it would seem that the principle of standardisation could be applied to nearly all the small plant at a colliery, but, unfortunately, this is not so. Take, for example, the item of pit-tub wheels; not only is there no standard size for these throughout the industry, but the dimensions and capacity of the tubs frequently differ as between one colliery and another in the same district. These variations are accounted for by the diverse underground conditions, such as the thickness of the seams, their inclination, whether the coal is won by hand or is machine cut, the size of the roads, the particular system of haulage employed, the gradients to the pit-bottom—in fact, by the general mining methods which may vary not only from pit to pit but even from seam to seam. We could adduce instances of collieries working practically side by side at one of which the tub capacity is 18 cwt., requiring a 40-lb. rail, while at the other the tubs take only 11 cwt. and call for nothing heavier than a 28-lb. rail. However, it is not suggested that anything approaching absolute uniformity can be secured, nor, indeed, is it aimed at; but that a large reduction in the numberless patterns that foundrymen now have to provide could be effected must be obvious to everybody.

In America standardisation is one of the most marked features of industrial practice. Some of our people consider that it is carried to extremes there, and are fearful that its adoption here would tend to destroy that individualism which has played so great and so characteristic a part in the development of our engineering industry. We do not consider that this objection can be sustained; the advantages of standardisation must outweigh any arguments that can be urged against it, especially when, by the very nature of the factors governing the mining industry a sterile uniformity, happily, is unattainable.

In the work of the regional committees, to which we have already referred, we assert the foundrymen should be invited to co-operate; we are satisfied that they could be extremely helpful, and that by assisting in the selection of standards for the particular district they would gain a more complete knowledge of the problems confronting the colliery manager, and with a more personal acquaintance with his requirements they would be better qualified to meet them.

German Method of Costing in Foundries.

The German Union of Iron Foundries ("Verein deutscher Eisengiessereien, Giessereiverband"), embracing most of the important iron foundries in Germany, have recently printed as a manuscript a monograph on the principles of costing in iron foundries. This very instructive booklet is intended to afford a sound basis of costing, and, with the tables printed at the end, enables any foundry to arrive at an approximate cost for a series of castings, even where they have no elaborate system of costing in operation.

In arriving at a general basis for the calculation of cost, the five principal headings should be considered, viz.: (1) Cost of liquid iron; (2) total productive wages; (3) overhead charges; (4) selling or commercial expenses; and (5) percentage addition for profit.

(1) Cost of liquid iron includes the following items:—

Pig-iron and scrap, plus any additions in order to obtain special mixtures, such as ferro-silicon, etc. Bed coke, charge coke, limestone, and other smelting materials. Metallic losses, scrap and discard. Wages for cupola men and other hands. Freight charges, charges for conveyance, unloading, etc., of above-mentioned materials. Maintenance of cupola furnaces, materials, and repairs. Power required for blowers, furnace hoist, and pig-breakers. Laboratory costs.

(2) Total productive wages include wages for moulding, pattern-making, and fettling the castings, including apprentices' wages and any special expenses necessary.

(3) Overhead charges. These should include:

(*a*) all materials and sundries, with the exception of those coming under the heading of liquid iron. Under heading (3) come moulding sand, core sand, coal dust, graphite, charcoal, drying oven coke, straw rope, oils and fats, sand-blast sand (for fettling), wrought iron, wood for firing, timber, shovels, riddles, files, ladles, emery wheels, bellows, and other sundries.

(*b*) All wages connected with oncosts (overhead charges), such as labourers, smiths, joiners, crane drivers, sand mixers, drivers, etc. (*i.e.*, all wages with the exception of the productive wages considered in section (2), or furnacemen's and unloaders' wages); any wages due to rejects, provided payment of such wages has been agreed upon.

(*c*) All other working expenses, *e.g.*, wages or salaries of technical staff, foremen, etc., including insurance for sickness and invalidity; all statutory contributions to societies or pension funds; all expenses for transport (horses, carts or lorries, etc.); all amounts that have to be written off plant; replacements and repairs to tools; power consumed, no matter method of transmission used, but excluding power for blowers, etc., as in section (1); total cost of heating and lighting the works; cost of maintaining the buildings, or lease or rent of foundry; maintenance and storage of patterns, etc., of all kinds; storing and warehousing costs.

(4) Selling or commercial costs. These include all salaries and wages of the commercial staff, including insurance, etc. Insurance against breakage (of castings), travelling expenses, commission, advertising expenses, etc. Insurance against fire, responsibility, damage due to accidents. Interest (including that on working capital), industrial taxes, rates, etc. All other commercial and office costs, and amounts spent on welfare, etc.

(5) Percentage addition for risk and profit. This includes the ordinary manufacturing risk in general. The risk of discard, rejections, etc., had already been included in the expenses for the liquid iron; and any wages payable for rejected castings, etc., under the heading of overhead charges (3).

Standard Basis.

The standard basis proposed for arriving at the cost of castings is arrived at as follows:—

Productive Wages.
\+ 200 per cent. overhead charges on these,
\+ *Liquid iron.*
= Total cost of production,
\+ *15 per cent. commercial charges*
= Total of prime cost.
\+ *12 per cent. for risk and profit*
= Minimum selling price,
\+ *Any special additions*, for special types of castings and additional risk of rejection
= Selling price.

On the basis of the above, the monograph contains a list of tables showing the minimum selling cost per 100 kilos. (about 2 cwt.) of a given casting in any one of twelve groups, these groups being according to weight and running from 1 kilogram (2.2 lbs.) to 5,000 kilograms (about 5 tons). The productive wages are graded from about 3s. to 21s. per 100 kilos. of castings for certain districts in Germany, but are on a higher scale than this for certain districts. There are tables for West Germany (occupied territory), South Germany, and North, Central and East Germany. The tables are arranged as a *pons asinorum*, and enable the rough selling cost to be read off at once for any rate of wage or any weight group. Provision is also made for dealing with intermediate weights.

Tables are also given showing how the costs of the liquid iron are arrived at. Taking a normal type of burden for high quality machine castings, by way of example, the cost of materials works out:—

	Per 100 kilos. d/d free. Gold marks.	Per cent.	Burden No. 1. High-quality machine. castings. Gold marks.
Hematite ..	11.10	25	2.77
Foundry pig I ..	10.10	25	2.53
Low carbon iron	14.00	10	1.40
Machine scrap ..	9.00	40	3.60
			10.30

NOTE: 1 Gold Mark = 1s. 1½d. approximately.

Thus the bare cost of the materials for the quality of casting mentioned works out at 10.30 G.Mks. For normal castings, Type II, the costs works out at 9.72 G.Mks. per 100 kilos. The average smelting costs come out at 1.50 gold marks per 100 kilos. of metal. The cost for the liquid iron, taking castings weighing up to 1 kilogram (weight group No. 1) would therefore work out as follows:—

Castings as finished:	100 kilos.
Discard ..	8 ,,
Waste ..	200 ,,
Metallic loss ..	21.56 ,,
	329.56 kilos at 11.22 Gold Marks per 100 kilos = 36.97 Gold Marks
Less own scrap, 208 kilos at 9 Gold Marks per 100 kg.	18.72
Net cost of production for 100 kg. of iron	18.25 Gold Mks.

Now taking this figure of 18.25 G. Mks. for 100 kg., let us take an example to show how the minimum selling price is arrived at per 100 kg. in the same weight group No. 1:—

	Gold Marks.
Liquid iron productive	18.25
Basic wages, *say*	14.00
200 per cent. on wages	28.00
Cost of production	60.25
Plus 15 per cent. commercial or selling costs	9.04
	69.29
Total prime cost for 100 kg.	69.29
Plus 12 per cent. for Profit and Risk ..	8.31
Minimum Selling Price	77.60

Let us say that a firm writes to a foundry for a quotation for 30 sets of complete castings for

a machine, and wants an average price. The calculation would be effected as follows:—

	Weight of each part kg.	Total productive wages per 100 kg.	Weight group.	Selling price of per 100 kg. as per tables.	Selling price of casting mentioned.
				G. Mks.	G. Mks.
1 Frame ..	316	4.30	9	35.00	110.60
1 Turret ..	42	5.60	6	40.79	17.14
1 Slotted disc ..	18	7.60	5	49.19	8.85
4 Bracks. Total	260	4.50	7	36.18	94.07
2 Tables ..	166	6.25	7	42.94	71.28
2 Slides ..	90	5.10	6	38.86	34.97
7 Parts, Group 1	7	12.40	1	74.64	5.22
11 ,, ,, 3	35	8.95	3	56.40	19.74
2 ,, ,, 3	9	7.25	3	49.82	4.48
2 ,, ,, 4	12	6.80	4	46.98	5.64
3 ,, ,, 5	42	6.00	5	43.00	18.06
997 kg. total weight of the complete machine					390.05
Add amount for special discard risk on the frame, as it has ring bearings cast on ; 10 per cent. of G. Mk. 110.60, as above					11.06
Total selling price ..				G. Mks.	401.11

Average selling price for 100 kilos = 40.25 Gold Marks. This price is nett cash, delivered factory, excluding packing, cost of patterns, etc.

IN FACE OF KEEN COMPETITION, the Metropolitan-Vickers Electrical Company, Limited, have secured the contract for the electrical equipments for the Sydney Suburban Railways electrification, amounting to nearly half a million pounds.

SIR EDWARD JOHNSON-FERGUSON, for the last 19 years chairman of the board of Bolckow, Vaughan & Company, Limited, has retired from the chair in consequence of ill-health. The Hon. Roland D. Kitson has been elected chairman of the company for the time being.

SOME 500 MEMBERS AND GUESTS attended the 29th annual dinner of the Institute of Marine Engineers at the Hotel Cecil on Friday last. Sir Westcott S. Abell presided, and those present included Sir W. Peter Ryland, Mr. W. Berry (Director of Naval Construction), Commander Sir Trevor Dawson, Sir J. Fortescue Flannery, Mr. J. Herbert Scrutton (chairman of Lloyd's Register of Shipping), Sir A. R. Duncan (vice-president Shipbuilding Employers' Federation), Sir Arch. Denny, Mr. Ernest E. Adams (chairman of Lloyd's), Captain H. Riall Sankey, the Right Hon. John Hodge, Sir J. E. Petavel (Director of National Physical Laboratory), Professor T. B. Abell, Messrs. T. Carlton (Engineer-in-Chief to the Board of Trade), Tom Westgarth (president of the Institution of Engineers and Shipbuilders of the North-East Coast), A. E. Faulkner (Director of Sea Transport), J. Brodie (president of the Liverpool Engineering Society), C. Hipwood (Secretary to the Marine Dept., Board of Trade), James Adamson, V. C. Faulkner, and Wesley Lambert.

A PROPOSAL TO build steel houses in Lanarkshire has been discussed at a meeting of the Lanark Middle Ward Committee. The Housing Committee reported that G. & J. Weir, Limited, had offered to erect on foundations prepared and supplied by the firm 50 houses of the "Cathcart" type at the price of £395 per house, or 12 pairs of the "Eastwood" type at the price of £390 per house. The Clerk submitted a statement showing that a rental of £30 10s. would require to be charged for the "Eastwood" type and a rental of £32 for the "Cathcart" type. It was agreed that in the first instance the Clerk should approach Messrs. Weir with a view to obtaining a further modification of the price quoted by them. In the course of the discussion Mr. W. B. Thomson suggested that the matter should be delayed, as he understood that the inside of the steel sheets were liable to corrode and become useless unless they were properly prepared and treated. Mr. Tonner, chairman of the Housing Committee, pointed out that they had given up the idea of building steel houses for the present unless they could get such a reduction in the price as to allow a satisfactory rent to be charged. The Clerk stated that the Scottish Board of Health, who had considered the scheme, were prepared to allow the committee to accept an offer for the supply of steel houses, and to grant a subsidy.

Birmingham and the Swedish Iron and Steel Industry about 1765.

Among the Foreign State papers preserved in the English Record Office in Fetter Lane there is a small file which throws an interesting light on the "practices of the Swedes at Birmingham" in about 1765. It appears that in that year a pocket-book was found which had been left behind by a passenger in "the Birmingham fly," and contained sundry papers, among these a testimonial, dated April 12, 1763, for Francis Lloyd, a moulder, issued by "Roebuck's house with whom he had lived." John Roebuck, who was then in partnership with Garbett and Cadell of the ironworks on the River Carron, was no doubt applied to for an explanation, and considered it his duty to report the matter to Lord Halifax.

The most "compromising" document found was a letter dated Stockholm, March 22, 1765, from Count Eckebladt, the Minister to Baron Nolcken, the Swedish Secretary in London, in which the latter was informed that when Mr. Kierman, the Swedish Intendent of Commerce, was in England, rather more than a year before, he endeavoured to persuade "one Mr. Boulton, an artisan in Birmingham not far from London," to come to Sweden to establish "an iron and steel manufactory" there. No further proposals have been made to him since, but as the States of the Empire were then considering that matter, the Count desired the Baron to consult Dr. Solander—who was then already resident in England and was thoroughly acquainted with the case—and to take with him the necessary steps for persuading the said Boulton to come and settle down in Sweden. The Baron is to give him all manner of encouragement to induce him to accept the Swedish Government's invitation. The letter concludes by a warning to his Excellency that he must proceed in the matter prudently and privately, as the English as a nation are very jealous of their manufactures.

The other papers found were of less importance. One was a letter containing a proposal from Johan Cahman, of Gothenburg, to the said Lloyd to go to Sweden, another from Mr. Prescot, M.P., meant for a man of the name of Downing, of Little Dawley, Shropshire, to have the passengers going to Cahman ready by a certain day in May, 1764; then there was an agreement made by Downing on behalf of "Cahman the Swede" with three men—one Lloyd, one Glover, and one Roper, and signed by them. In another letter Downing's brother was asked "to supply Lloyd," and was referred to Mr. Prescot for payment.

According to the report on the papers, "the thing" seems to have stopped there. At least apparently no steps were taken to stop "the emigrants," nor was it known whether the decoyed workmen actually got to Sweden or not. The Swedish Secretary, in his reply, dated April 19, 1765, stated that he had seen Solander, who was to go to Birmingham "for the safer and surer effect."

Finally Mr. Farquharson, of the Roebuck firm but not a partner, wrote on July 6, 1765, in answer to a letter from Mr. Stanhope, that Dr. Solander had not lately been to Birmingham, where few people knew him, but about two years before he had recommended two or three Swedish gentlemen to see their manufactures. Further, that Boulton was "a very considerable man who had lately raised works costing £6,000, and had been but little from home." According to another letter, Kierman had tried to "tamper" with Boulton at Birmingham. Farquharson promised to send what further intelligence he could get, but according to our report no further steps were taken or further intelligence was received since.

Boulton or Bolton, as his name was sometimes written, was of course Matthew Boulton, of the Soho Foundry, who subsequently became the partner of James Watt. His biographers do not mention this incident, but Mr. T. S. Ashton, in his recently published book on "Iron and Steel in the Industrial Revolution" (Manchester University Press), briefly touches upon the "conspiracy," basing his account on the Calendar of Home Office Papers. Downing was to be dealt with according to law.

XUM

The Selling of Castings.—III.

By VOYAGEUR.

In one sense the market for castings needs no analysis, for the simple reason that these goods are not a new and untried product, nor a new variety of an old product; the founder has probably been making and selling castings for a good many years. But, in spite of this, it remains a fact that few markets, even those for castings, have been exhaustively investigated with a view to attacking them systematically. It is true that the founder knows he can sell castings to shipbuilders or automobile manufacturers or railway companies, and therefore does not need an elaborate market analysis to tell him so. But the point is, does he know what other industries can absorb a portion of his produce, and to what extent is he receiving orders from these other industries? A market analysis not only reveals the industries that can buy castings, but it also, if efficiently carried out, indicates with some degree of accuracy whether a proportionate share of the orders these industries can give is being received.

In conducting a market analysis, it is necessary to know what to search for and how to search for it. The founder who tackles this operation of selling seriously will find it his best plan to draw up a list of queries and set to work to answer them fully and thoroughly. These are the chief queries:—

(a) In addition to the industries that are already absorbing my castings, what other industries are there that need castings of the kind I make?

(b) Where are these industries, if any, situated? What is their importance expressed relatively in capital and number of people employed?

(c) What are their buying principles?

(d) How best can I reach them for selling purposes?

These four questions give what may be described briefly as the main heads of the market analysis, but in turn each question can be sub-divided into others more detailed. Some space must be devoted to an enumeration of these questions because of their importance. The answers to them will form the groundwork for the construction of a clear and coherent sales policy—a policy that will affect all the selling activities; therefore it is essential that they should be answered fully, and with a strict attention to scientific accuracy, so far as this can be obtained.

1. What do these industries use castings for?

2. In endeavouring to sell to them on a larger scale than heretofore, am I likely to meet severe competition, and, if so, from what source?

3. Of these industries, which is likely to use the most castings? Why?

4. What is the past, present, and potential state of trade in each of these industries? What relation does this bear to the quantity of castings absorbed annually?

5. How do my prices compare with those of competitors in Great Britain?

6. How do my prices compare with those of competitors from abroad?

7. Who is responsible for placing orders in these industries, and on whose recommendation are these orders allotted to a particular supplier?

8. Can repeat orders be obtained, or are the requirements of the customer merely occasional, i.e., for replacements of machinery?

9. Is the demand for castings in these industries constant, irregular, or seasonal? What conditions govern the fluctuations of demand?

10. What is the percentage of my selling costs in relation to (a) selling price; (b) profits; (c) total turnover?

11. To what extent do my competitors advertise? How do they advertise? In what journals?

12. Do competitors publish any special literature or propaganda for the purpose of making sales?

It may be argued that this is a needlessly lengthy list of queries, but in practice it will be found that a carefully compiled reply to each will in due course give most useful data on which to build the marketing schemes. For example, one foundry discovered that its total of orders from collieries represented less than one hundredth of the total consumption of castings by the coal-mining industry. Obviously, there was a serious defect in the selling scheme. An attempt was at once made to obtain more business from collieries, and, within six months, sales to these had gone up over 50 per cent. This is the unsuspected sort of fact that a market analysis reveals. In another instance a firm of founders had been receiving orders for many years from a firm in a particular industry, had executed them, and had left the matter there. Then, one day, having initiated a market analysis, it occurred to this firm that since one firm in this industry ordered castings from them, another might, and a campaign was begun for the purpose of selling more castings to this particular industry. The result was the opening of many new and lucrative accounts.

It is idle for any manufacturer to pretend or believe that he has thoroughly covered every industry in which his goods are used unless he has first carried out a market analysis to test his beliefs. But one may now ask with some justification how all the questions enumerated so carefully are to be answered.

It would be redundant to describe every method in detail, but a few suggestions may prove of use. The writer does not wish to encourage the habit of spending great sums of money on these preliminary investigations. Their cost should be kept as low as possible. There are agencies that undertake the investigatory work outlined, but they are usually expensive to employ, and there is no guarantee that their work will be efficiently performed. Some manufacturers send out special commissioners from their own staffs to collect all the data possible; but this again is an expensive plan, and success cannot be guaranteed unless the investigators have been specially trained for the work. Furthermore, it is a slow method.

A quite useful market analysis can be conducted by analysing judiciously the information contained in Blue Books and Governmental Reports; by gathering together into a compendious form the reports of salesmen in the various districts affected; by carefully perusing trade journals, the records of trade associations and their miscellaneous compilations; the census returns; directories, and so forth. It must be borne in mind that complete accuracy is an ideal not yet attainable, though this does not mean that the work should be carried out in a slovenly and unmethodical fashion. The information obtained from the sources indicated should be properly supplemented by the salesmen and the expert engineers employed by the founder himself.

The salesmen are in daily contact with the industries and markets it is desired to attack; they know just what prejudices and resistance will have to be met in a particular industry; they know what arguments buyers advance in favour of a particular competitor's castings; they know the extent of competition, and so on. The engineers know the suitability of the castings to a particular use, and can, when called upon to do so, supply facts and figures concerning output and delivery.

Sometimes, before launching a serious sales campaign intended to operate over the whole country, it is advisable to localise it in order to determine what success it is likely to have, before going to any large expense. Thus, a founder might attack general engineering shops in the Glasgow district only before venturing on a national campaign. In this way he could test, at a comparatively small cost, the efficacy of his selling schemes. If these failed when applied to general engineering establishments in Glasgow, it is fairly certain that they would fail equally when applied to general engineering establishments in London, Birmingham, Manchester, and elsewhere. A preliminary localised campaign of this kind is usually executed by intensive circularising, which has for its object the drawing of replies from the potential purchaser, stating the general nature of his casting requirements on a questionnaire sheet sent for the purpose. As a rule, 10 per cent. of replies is good. If this quantity is received, the information given will prove very valuable as an indication of how the land lies in a particular industry. But both circular letter and questionnaire will have to be very carefully worded.

The Grain Size Grading of Moulding Sand.

By H. C. Dews, Assoc. Met.

The comparative novelty of chemically and physically analysing a moulding sand and the enthusiasm aroused by the wealth of guidance thereby revealed has distracted the attention of investigators from the necessity of correlating their results, and, what is even more important, of carrying out their tests in such a manner that they may readily be duplicated. The grading of the grain sizes, which is never of small account and may in many cases be the most important test in evaluating the sand, is complicated because of this lack of standardisation among research workers. Indeed, the small foundry manager will obtain only a meagre portion of the full value of this test unless he is prepared to undertake a mass of laboratory work more or less in repetition of what has already been accomplished by other workers. It may help to remove some of this confusion to review the claims of those who believe in the importance of grain size grading and of those who know of its drawbacks and also the methods of conducting the test.

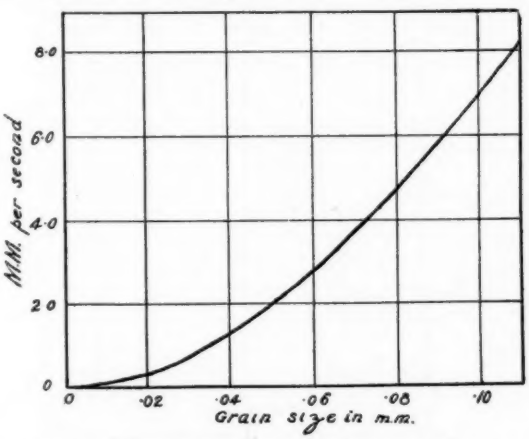


FIG. 1.—CURVE SHOWING THE HYDRAULIC VALUES OF GRANULAR QUARTZ PARTICLES.

The first object in grading a sand according to grain size is to determine the permeability of the sand, or, to use the foundryman's expression, to find if it is "close" or "open." Direct tests to measure the permeability, such as the one in which the time taken to force a measured amount of air or gas through a standard column of sand is measured, have been occasionally suggested; but only the grading of the grain sizes, upon which the permeability really depends, has been generally approved as a test of permeability.

A certain degree of permeability is essential in a sand mould in order that the steam and other gases liberated from the sand and metal shall be able to escape freely through the mould. In general, the higher the temperature of the molten metal the better vented must be the mould into which it is poured, although some other considerations may also affect the choice of permeability. For example, it is clear that if the mould is so open as to allow gas to escape freely, a fluid metal may also be able to percolate slowly into the sand. Many metals possessing a great chemical affinity for silica will also, on account of the greater surface exposed, attack an open sand mould more readily than if a closer sand were used. The result of either of these occurrences will be that the casting will be found to have a bad surface. To reconcile the necessity for an open sand to allow gas to escape with the need of a close sand to give a smooth surface to the casting, it is common practice to face a fairly open sand mould with a coating of very fine material—china clay or plumbago, for example. The efficacy of mould washes may be disputed from points of view other than that given above as the reason for their use, and although the practice may be essential in some cases, mould washes are very often used unnecessarily merely because they provide an easy means—apparently—of overcoming an obvious difficulty. In a host of cases a close study of the grain sizes of the moulding sands along with their other properties would lead to much simpler moulding practice.

A sand made up of even-sized large grains will offer the maximum permeability. This permeability will decrease regularly with the grain size, always providing all the grains are of the same order of size. When several degrees of size are present in large proportion, to forecast the permeability of the mould is more difficult. The fine grains may be in sufficient amount readily to fill the interstices left between the larger grains, and the resulting mould will be less permeable than if a sand of even-sized grains were used, even if the grain sizes were less than the average grain sizes of the uneven mixture. Further to complicate this case, it has been shown by several investigators that the clay or bond in a moulding sand is mostly concentrated in the finest grains, so that, even where the maximum permeability is sought, a certain amount of the smallest grain size must be admitted. Otherwise an artificial bond must be used.

When the average grain size of the sand is decreased the amount of exposed surface of the grains is increased, and in order that this surface shall be sufficiently covered with binding material to insure the required cohesion between the grains, a larger quantity of bond must be postulated.

To give a quantitative value to these observations is more difficult than their mere enunciation. Although there are strong arguments in favour of expressing grain size as the average measurement of the diameter of the grain in millimetres, there seems a reluctance on the part of many investigators to adopt this obviously simple and scientific classification. As will be seen later, the various methods of grading yield results in terms peculiar to the apparatus employed, and the extra effort to convert these to a standard classification is too often spared. Amongst mineralogists the following arbitrary grading (Table I) has been adopted, and there seems no reason why foundrymen should adopt a different system:—

TABLE I.—*Normal Standard for Grading Sand.*

	Average diam. of grain.
Coarse gravel	10—5 mm.
Fine ,, ...	5—1 mm.
Coarse sand	1—0.5 mm.
Medium ,, ...	0.5—0.25 mm.
Fine ,, ...	0.25—0.10 mm.
Coarse silt	0.1—0.05 mm.
Fine ,, ...	0.05—0.01 mm.
Mud, slime or clay	under 0.01 mm.

There are three common methods of grading sand according to its grain size:—(1) Screening, (2) elutriation and (3) sedimentation. Each method possesses some advantages and some drawbacks from the practical point of view.

Screening.

In the method of screening it is customary to pass a known weight of sand—say 100 gms.—through a nest of sieves of varying mesh and to weigh the amount of sand retained by each sieve. The maximum size of mesh used is sometimes as large as 6 or 7 mesh to the linear inch. Such a mesh will only retain grains over 2 mm. dia., but as only very small fractions of any moulding sand—worthy of the name—are retained by such a grating, its use appears unnecessary. A mesh to retain grains of 1 mm., or even slightly smaller, is large enough for the first size. The other sizes in common use in Britain and in America are detailed in Table II, which also gives the approximate size of grain retained by a wire mesh sieve of the size stated.

There appears to be some difficulty in obtaining accurate sieves below 100 mesh, probably because the manufacturers have not yet sufficiently appre-

ciated the insistent demand. The larger sieves are manufactured by methods which vary so much that analyses performed in different laboratories are seldom concordant. There is thus a great need for a standard specification for this apparatus. Such a specification should enunciate a list of sizes and shape of mesh, should fix the maximum variation of the mesh from the declared size, and should define the gauge of wire to be used in each case. The last point is of special importance, as slight variations in the wire gauge exert a great influence on the size of grain which will pass through the sieve, even though the apparent mesh size is altered to an almost infinitesimal extent. It may be more convenient and accurate to make the larger sizes from punched plate, as has been suggested by the Institute of Mining and Metallurgy, but whatever practice is adopted should be definitely controlled and universally accepted.

The usefulness of screening methods of classification is at present confined to the sand grades, and it is not practicable to expect to make any further sub-division below 0.1 mm. dia. Much of the information required by the foundryman can only be supplied by means of a quantitative

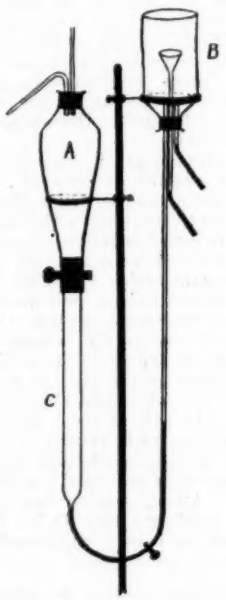


FIG. 2.—ELUTRIATION PROCESS.

separation of the silt and mud grades, and it follows therefore that an analysis by sifting alone falls considerably short of the desired result.

Elutriation.

The method of grading by elutriation depends upon the fact that under certain conditions an upward flowing current of water will carry away all grains below a definite size, and will leave behind all above that size. The size at which this quantitative separation is effected depends upon the water speed. The minimum size of granular quartz grain which will remain behind in upward flowing currents of water at various speeds is shown in Fig. 1. A common type of apparatus by which elutriation separation is carried out is illustrated in Fig. 2. A weighed amount of sand is introduced into the cylinder A, up which a steady current of water is flowing. The water current is suitably adjusted by the constant head B. The sample is separated into three grades depending for size on the water velocity. The coarser grade settles into the cylinder C, the medium grade is retained by the water in A, and the finest particles are washed over.

The factors which influence the accuracy of this method of grading are:—(*a*) The type of apparatus used; (*b*) the rate of elutriation; (*c*) the temperature of the water; (*d*) the shape of the grains; and (*e*) the density of the grains.

The first three factors are simple to control once agreement is reached upon the exact experimental conditions of the test. To eliminate the effect of the shape of the grains the apparatus must be standardised for the particular *type* of sand to be tested. The effect of the difference in density of the grains decreases with the grain size, and is almost inoperative when grains of the order of the silt sizes are elutriated. Because of this density interference the test is not of sufficient accuracy to be used for separating above 0.1 mm. As a means of classifying the silt and mud grades the method is very suitable, and by its aid the information lacking after screening may be added to complete the full grading of the sand.

No apparatus has yet been designed which will grade sands below 0.01 mm. grain size accurately and easily, nor does there appear to be any practical use for such a refinement. The permeability of a sand below 0.01 mm. grain size is so low that for foundry purposes it may be regarded as non-existent. Our present knowledge of the physical properties of moulding sands has not revealed any factor important from the foundryman's point of view other than permeability, which may be investigated from a study of the grain size grading, so the classification down to 0.01 mm. dia. supplies all the information grain size grading is capable of contributing.

Sedimentation.

It should be borne in mind that the two previous methods classify the grains in percentage by

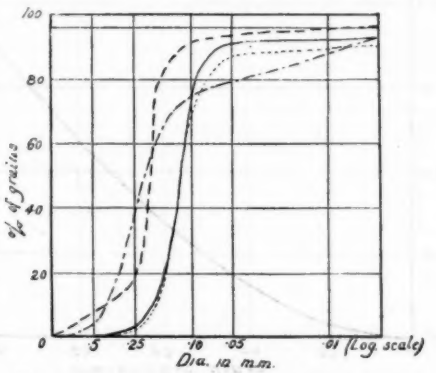


FIG. 3.—GRAPHICAL REPRESENTATION OF GRAIN SIZE GRADING OF MANSFIELD SANDS.

weight, whereas the method now to be considered analyses the sand grains by volume percentage.

For this test a tall, cylindrical glass vessel is required. A graduated measuring cylinder may be used, or a specimen jar about 14 in. high and 1½ in. dia. fitted with a glass stopper may be purchased, and is very suitable. The vessel should be half-filled with sand, filled to the top with water, and shaken violently. It must be then put

TABLE II.—*Sizes of Sieves used for Grain Size Grading of Foundry Sands.*

America.	Britain.	Approximate minimum size of grain retained by British sizes.
20	30	0.6 mm.
40	60	0.25 mm.
60	90	0.15 mm.
80	120	0.1 mm.
100	200	0.065 mm.

aside and the sand allowed to settle undisturbed. On examination after a time the coarser grains are seen settled to the bottom of the vessel, the finer grains on top of these, and finally above all the fine clay substance. The various layers may be thus measured and a rough computation of the proportion of the grades may be obtained. The test is not by any means conclusive, and it is difficult to arrange the experiment so that really quantitative results may be recorded. It has the advantage, however, that it may be performed in any odd corner of the foundry without any special technical skill. As a means of comparing the grain sizes of two or more sands, this method is very useful. In some foundries several exactly similar vessels are provided, each being marked at the same height. One is filled to the mark with

a standard suitable sand, shaken and allowed to settle. When new consignments of sand arrive in the foundry it is only necessary to pour a sample up to the mark in one of the spare vessels, shake, settle and compare with the standard. Each new batch of sand can thus be adjusted to standard conditions. This appears to be the only approach to permanent value the results of this test will survive to reach.

Recording Results.

The method of recording the results of these tests deserves some thought. The results are obtained, of course, in percentage fractions of the sand which lies within certain maximum and minimum grain diameters. Such results may be expressed in tabular form, as in Table III, where a Mansfield sand as investigated by two well-known authorities has been set out. Columns of figures of this nature are to some tedious to follow, and a graphical method due to Prof. P. G. H. Boswell has been frequently used. The data in Table III is plotted in this manner in Fig. 3. The percentage by weight of the sand above certain grain sizes is plotted vertically against the grain sizes marked horizontally. Where the curve is steepest there occurs the greatest proportion of the grain sizes over which the steep curve extends. Similarly a flattening of the curve indicates that the grain size covered by the flat portion is present in only small quantities. With a little practice these curves are fairly easy to follow, but it is doubtful if any practical foundryman except those to whom a graphical representation is a fetish would take the trouble to master these curves. A simpler method of showing the same results is shown in Fig. 4. This method, if not truly scientific, has the advantage of being easy to follow and simple to visualise. Each column of a standard width represents a sample of sand. The proportions by weight are set off vertically, and the amounts of the various grains are indicated by blocks of shading. A key to the shading is appended.

The two totally different sets of figures given above for the grain size grading of a Mansfield sand as obtained by reputable workers illustrate the result of the present lack of co-operation among research workers and the way in which the practical man may be therefore confounded. There seems to be a call for a public body such as the Institute of British Foundrymen, or one of the metallurgical societies interested in this question, to form a committee to prepare a detailed authorised method of grain size grading, and at the same time the units in which the results may be reported should be definitely specified.

TABLE III.—*Grain Size Grading of Samples of Mansfield Sand.*

	<1.0 mm. >0.5	<0.5 > .25	<0.25 >0.1	<0.1 >0.05	<0.05 >0.01	<0.01
1. Before milling (Boswell)	7.5	9.2	74.8	3.9		4.6
2. After ,, ,, ...	4.1	33.3	37.5	6.8		13.6
3. Before ,, (Holmes)	0.5	2.4	70.8	16.7	1.3	8.3
4. After ,, ,, ...	0.5	1.8	63.5	21.1	2.2	10.9

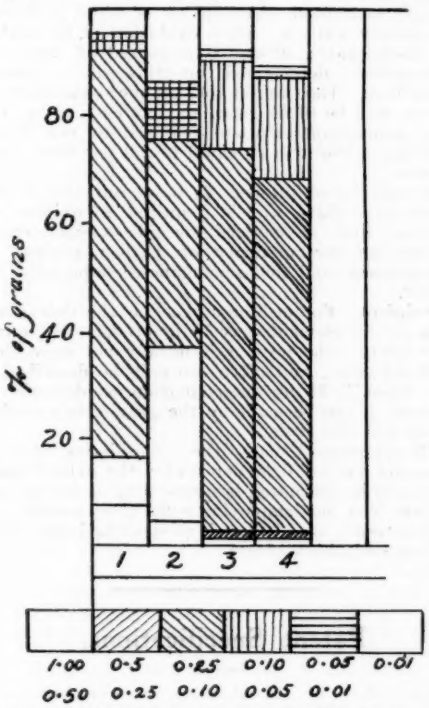


FIG. 4.—METHOD OF RECORDING RESULTS OF GRAIN SIZE GRADING BY MEANS OF BLOCK SHADING.

Standardisation of Colliery Requisites.

A general meeting of the Mining Institute of Scotland, held recently in the Royal Technical College, Glasgow, under the Presidency of Professor R. W. Dron, and attended by representatives from the Scottish Branches of the National Association of Colliery Managers and the Association of Mining Electrical Engineers, had been arranged for the purpose of hearing an address from Mr. C. le Maistre, C.B.E. (Secretary of the British Engineering Standards Association) on the subject of "Industrial Standardisation with Special Reference to Colliery Requisites." It will be recalled that an address by Mr. le Maistre on the same subject was delivered before the Manchester Geological and Mining Society.

The LECTURER said he was not, of course, competent to come amongst a body of mining engineers and advise them in what direction they should apply simplification in order to obtain the maximum result in the quickest time. That was for the Regional Committee to consider. From long experience—now extending over 23 years—he was convinced that great economies could be effected in the materials and apparatus of all sorts used in the mines through judicious simplification. In the case of rails or of pit-tub wheels, when one heard of the number of types and sizes at present in use, it was not difficult to see that even a small reduction would bring about pretty considerable savings, to say nothing of more rapid delivery of replacements. That any manufacturer should catalogue over 2,000 patterns of tub wheels differing only in minor details was surely an object lesson in national waste. Objections to standardisation were usually to the effect that it interfered with invention and design, and especially with individuality, that it tended to produce crystallisation and eventually to stultify general progress. No doubt such objections were very real and could only be dealt with satisfactorily by the strict application of proper safeguards. A certain amount of opposition to the work of standardisation was to be expected, but in these days it was somewhat expensive to be individually inclined. If an engineer, for instance, wished to insist upon his individuality he could always be accommodated—at a price—but the ordinary average man one would think would prefer to use materials and apparatus produced in accordance with national standards and so secure the resulting saving in cost, more especially if through proper organisation his firm were able to take part in the setting up of these standards. It was true that there were a certain number of fanatics who would standardise everything, but extremists in any walk of life had to be firmly opposed. He hoped the discussion might be useful to the Committee which, at the request of the Mining Association of Great Britain, had been set up under the ægis of the B.E.S.A. to organise the national simplification of colliery requisites.

Analysis of Grey Iron Foundry Alloys.—IX.

Sulphur in Ferro-silicon and Silico-spiegel.

The amount of sulphur present in ferro-silicon does not usually exceed 0.07 per cent., while it is only present in "traces" in silico-spiegel; hence it follows that in consideration of the comparatively small quantities of alloy incorporated in a "change" or mixture of metal, such as used in a grey iron foundry, the amount of sulphur absorbed from the alloy by the iron is indeed small, if not, in fact, practically negligible. From the foregoing it is fairly obvious that determination of sulphur in these two alloys is unnecessary in ordinary routine works' practice.

If for special purposes or as a matter of interest it is desired to estimate the sulphur contents of either alloy, the procedure recommended is similar to that already described in Article VI of the series:—

Weigh into a 250 cc. tall form beaker 2.5 grammes of the finely powdered alloy, add 75 cc. of dilute HNO_3 (2 HNO_3 to 1 H_2O) and about 3 cc. of concentrated and pure hydrofluoric acid (HF), cover the beaker with a watch glass, and warm gently. The reaction is at first very violent, and if the sample is heated too strongly the estimation is very liable to be spoiled owing to loss of solution caused by excessive "frothing"; it is for the purpose of avoiding this danger that decomposition of the sample should be carried out in a beaker as suggested.

The gentle heating is continued until the alloy commences to decompose steadily, then heat to boiling, and boil until decomposition is complete; this usually requires 35 to 45 minutes. Carefully transfer the solution to a 4-in. dia. evaporating basin, add 2 grms. of KNO_3 and proceed exactly as in the case of cast iron. A blank estimation should be made by treating a 2.5 grm. sample of standard cast iron with the same quantity of dilute HNO_3 and HF as used for decomposition of the alloy sample, and transferring the solution and residue to an evaporating basin, and proceeding as already described.

Phosphorus.

In low grade ferro-silicon the phosphorus content rarely exceeds 0.10 per cent., while it may be as low as 0.05 per cent.; in silico-spiegels containing 10 to 12 per cent. silicon it may be present in any quantity from 0.06 to 0.15 per cent. What has been stated in regard to the effect of sulphur in both alloys upon the metal produced from the mixture, applies equally to the effect of the small percentages of phosphorus present, and usually the phosphorus content can be ignored and need not be determined. A method of estimation (when required) which is rapid, accurate and applicable to both alloys is to weigh off a 2.5 grm. sample and treat in a 150 cc. tall form beaker as described for the determination of sulphur. When the sample is decomposed filter off the residue by means of suction through a pulp filter made of pulped paper (No. 40 Whatman) clippings.

Wash the residue with hot 2.0 per cent. HNO_3, two or three times, and transfer the filtrate to a 300 cc. conical flask; proceed as described for the volumetric method of determining phosphorus in cast iron—Article VII—except that 5 ccs. of $KMnO_4$ will be found ample to oxidise the carbon content.

To calculate the result, the percentage factor obtained for the standard cast iron is divided by 5 and the result multiplied by the ccs. of $\frac{N}{8}$ KOH required, the product equals the percentage phosphorus; or the product obtained by multiplying the original (on 0.5 gr. sample) factor by the ccs. required is divided by 5.

Spiegeleisen and Ferro-manganese.

Carbon.—The carbon content of these alloys may be regarded as existing wholly in the combined state, and the amount varies from about 4.5 in spiegeleisen to 6.5 per cent. in ferro-manganese.

Often there is a little graphite present in ferro-manganese, but this can safely be ignored.

The carbon content of spiegeleisen — or "spiegel" as this alloy is more often termed—can be determined in the usual way by direct combustion in oxygen, but it is more convenient to use half the sample weight (0.5404 grms.) employed for carrying out the estimation on cast iron.

For the estimation of carbon in ferro-manganese weigh out 0.5404 grms. of the sample and intimately mix with 5.0 grms. of thoroughly dry red lead of the best quality. The mixed sample is then transferred to a fireclay boat and burnt in a current of oxygen, as given in Article I.

A blank estimation must be made on the red lead, as the best quality of this material invariably yields a little carbon dioxide (CO_2) on heating in oxygen.

The amount of blank found is deducted from the total weight of CO_2 obtained from the sample and the quotient × 100 ÷ 2 equals the total carbon percentage, which may be expressed as "combined carbon."

Silicon.—The quantity of this element occurring in the normal alloys, does not usually exceed 1.0 per cent., and Drown's method—Article III—serves admirably for making an estimation, the sample weight should be the same as for cast iron.

Manganese.—This element is most satisfactorily and accurately estimated by the bismuthate method. The sample weight for spiegeleisen should, for preference, be 0.55 grm., and 50 cc. of the prepared solution of 250 cc. is taken for the determination of the manganese. The whole procedure and calculation being as described for manganese in silico-spiegel.

In the case of ferro-manganese, a 0.275 grm. sample is treated, the solution of which is diluted to exactly 250 ccs., after oxidation of the carbon by bismuthate; 50 ccs. is measured off and the manganese determined on this as previously described. The weight of sample equivalent to 50 cc. will be 0.055 grm., so that each cc. of ferrous ammonium sulphate required to react with the manganese will be equal to 2.0 per cent. manganese.

It may be of interest to point out that rather more bismuthate will be required to oxidise the carbon, than is required for silico-speigel, owing to the greater quantity of carbon present in spiegeleisen and ferro-manganese; especially the latter.

Sulphur.—For ordinary practice the determination of this element may be ignored, as the quantity likely to be present is usually not more than 0.01 per cent., and often can only be described as a "trace." If its determination or detection is desired, it can be made by the gravimetric method given for cast iron.

Phosphorus.—Usually the phosphorus content does not exceed 0.25 per cent.; the actual quantity may be estimated by proceeding as in the case of cast iron, but employing a 2.5 grm. sample.

The result is calculated as described for ferro-silicon and silico-spiegel.

Patent Specifications.

Particulars of complete specifications accepted, furnished by Mr. Eric Potter, Patent Agent, of Lonsdale Chambers, 27, Chancery Lane, London, W.C.2. Printed copies of the specifications in the following list are now on sale.

222,555. Moore, W. D. Method of and apparatus for casting hollow metal bodies.

222,556. Moore, W. D. Moulds for centrifugally casting metal.

222,566. Jonas, J. K., and Hunt, J. T. B. Annealing furnaces.

222,575. Speck, T. R., and Kennedy, W. J. Furnaces for annealing and tempering.

223,320. Lamberton, J. R. Machine for the production of broken pig-iron.

223,383. Kenyon, W. Sand-blasting machines.

211,462. Cornelius, C. E. Electric furnace for welding, tempering, burning or for heating for other purposes.

214,625. Soc. Anon. D'Ougree Marihaye. Machine for smoothing and re-smoothing the matrices of ingot-moulds and other hollow bodies.

221,494. Holley, E. Foundry mould cleaning, heating and lampblacking devices.

The Influence of Manganese on Cast Iron.

By J. E. Hurst.

In a previous article on the influence of sulphur in cast iron, the effect of manganese and its combination with the sulphur was discussed. By thus combining with the sulphur and converting it into an insoluble constituent in molten cast iron, the effect of sulphur in tending to prevent the formation of graphite is at once neutralised, and from this point of view manganese can be looked upon as a constituent which tends to soften cast iron. In this article it is proposed to confine the issue solely to the influence of manganese, apart entirely from any consideration of the sulphur content.

The maximum quantity of manganese likely to be met with in present-day irons from the blast furnace is, say, 3 per cent., whilst the minimum amount present is frequently as low as 0.10 to 0.20 per cent., and special irons such as certain Swedish irons and American washed irons contain even still smaller quantities. The typical manganese content of a variety of British pig-irons is given in Table I.

TABLE I.—*Manganese Content of Typical British Irons.*

Brand.	Mn. Per cent.	S. Per cent.	P. Per cent.
East Coast Hematite ..	1.00	0.03	0.045
West Coast Hematite	0.50	0.03	0.045
Lincolnshire Foundry	1.60	0.05	1.30
Derbyshire Foundry ..	0.30	0.04	1.50
Refined Iron	0.10	0.05	0.05

Rich ferro-manganese alloys are also prepared in the blast furnace containing quantities of manganese up to 80 per cent.

The Condition of Manganese in Iron-Carbon Alloys.

It is highly probable that manganese enters the iron-carbon alloy during smelting in the blast furnace as the carbide of manganese Mn_3C. Investigations have been conducted into the nature of the existence of manganese in the iron-carbon alloys by Stead, Hatfield, Levy and Arnold and Read. Arnold and Read have been able to show from an examination of the electrolytically separated iron-carbide residues that the manganese up to a percentage of 4.58 per cent. exists with the carbide of iron as a simple isomorphous mixture of the two carbides Fe_3C and Mn_3C. In higher percentages from 4.58 to 13.38 per cent. a large proportion of the two carbides is the true double carbide of iron and manganese $3Fe_3C\ Mn_3C$.

Mr. H. I. Coe* investigated a complete range of alloys containing 3.0 to 4.0 per cent. carbon and from 0 to 38.0 per cent. manganese. The amounts of silicon, sulphur and phosphorus present in these alloys were extremely low, and in no case did the silicon exceed 0.17 per cent. The whole of the test bars cast were white irons containing no graphite, and it is interesting to note that a bar containing 3.80 per cent. manganese, on drastic annealing at a temperature of 900 deg. C. followed by slow cooling, showed no graphite. Prolonged annealing of the lower manganese samples would, of course, result in the depositing of free graphite.

Coe also found that the addition of manganese resulted in a gradual lowering of both the liquidus and solidus temperatures of the alloys, and at a composition of 4.05 per cent. carbon and 29.80 per cent. manganese, both these freezing points were found to coincide, on which account this alloy is considered to be the eutectic alloy of the series. The total depression of the solidus temperature in this alloy amounts to about 15 deg. C. The eutectic alloy consists of the double carbide of manganese and iron, and a gamma-iron solid solution of this double carbide. As would be anticipated, an increase in manganese beyond the eutectic percentage results in the appearance of well-defined carbide plates in the microstructure.

With higher carbon alloys, from 4.0 to 6.9 per cent., West* found the liquidus point depressed up to a manganese content of 13 per cent., above which the liquidus point was gradually raised, until at 80 per cent. manganese it was as high as 1,250 deg. C. From a series of extensometer readings taken with Turner's extensometer on the cast bar, Coe was able to conclude that a complex arrangement of solid solutions of definite double carbides of iron and manganese were formed with increasing manganese content. Confirmatory evidence of these formations is to be had from the hardness curves from this series of alloys.

Manganese has a remarkable influence on the transformation in the solid alloys. Osmond, in his classical work, showed in low-carbon alloys that the temperature of the thermal transformations progressively coincide and are lowered. With 4.0 per cent. manganese the transformations are lowered to 300 deg. C. in an alloy containing 0.45 per cent. CC, and with a slightly lower combined carbon and 5.0 per cent. manganese the combined change point was lowered by 100 deg. C., until with 7.0 to 12.0 per cent. manganese no transformation was encountered on cooling down to the normal temperature.

In the higher carbon members of the series the Ar1 point was gradually lowered, and at the same time the magnitude and time occupied by the rest was diminished and spread out over a longer range of temperature. It is on this account that the experimental determination of the change point is rendered extremely difficult. For example, in a 5 per cent. managanese alloy Coe found no trace of a thermal arrest down to temperatures of 400 deg. C., but from the observation of the partial resolution of the austenite solid solution Coe was able to infer the presence of the change point in alloys containing manganese up to as much as 10 per cent. The observations of Coe are more or less confirmed by similar experiments made by West, and from these investigations it would appear that the influence of manganese in lowering the change points is not so great in the high-carbon alloys as in the low-carbon alloys. It is also of interest to note that in iron practically free from manganese the hysteresis of the pearlite point was found to be about 40 deg. C., whereas in the alloy containing 3.75 per cent. manganese this was increased to about 65 deg. C.

Influence of Manganese in Iron-Carbon-Silicon Alloys.

The influence of manganese on iron-carbon alloys containing silicon was also investigated by Mr. Coe, and his results are shown in Table II.

TABLE II.—*Manganese-Iron-Carbon-Silicon Alloy.*

Tot. C.	Gr.	CC.	Mn.	Si.
4.01	—	4.01	31.50	2.80
3.71	3.45	0.26	1.07	2.45
3.56	2.87	0.79	0.55	2.45
3.70	3.39	0.31	1.00	2.46
3.63	3.16	0.47	1.61	2.35
3.60	3.25	0.35	2.23	2.35
3.60	3.33	0.27	2.65	2.35
3.70	3.12	0.58	3.45	2.39
3.80	2.94	0.86	4.19	2.48
3.12	2.69	0.43	5.15	2.44
3.40	2.65	0.75	5.83	2.40

From an examination of the figures in this table it is at once noticed that even appreciable quantities have very little effect upon the condition of the carbon, and with quantities as high as 4.19 per cent., a percentage considerably in excess of commercial practice, the combined carbon value recorded is only 0.86 per cent. The effect of manganese was also found to be almost negligible on the temperature of the solidification arrests within the range of manganese percentages common to commercial practice; but in the case of the pearlite transformation the temperature of this point was found to be gradually lowered, as in the case of alloys free from silicon. This

* J.I.S.I., 1910, No. 2.

* Metallurgie VI, pages 3–14, Jan., 1909.

arrest point, however, disappears abruptly at 4.0 per cent. of manganese, and not gradually as in the case of the pure iron-carbon alloys. Herein probably lies the explanation of the greater hardness of the high-manganese-content irons of the series. The remarkable experiment of Hague and Turner,* which has a bearing on this subject, is often lost sight of. This experiment was performed in the course of their research on iron-carbon-silicon alloys. It was found that the presence of manganese even in a small quantity had a remarkable effect on increasing the graphite content. The authors went to considerable trouble to demonstrate this influence, or, in their own words, "this direct, stable graphite-forming tendency of the manganese." The following table is abstracted from their data, and serves to show the comparison between three different samples, differing only in their manganese and silicon contents.

TABLE III.—*Influence of Manganese and Silicon.*

No.	Fracture.	Si.	Tot. C.	Gr.	CC.	Mn.	H_1°C.	H_2°C.	H_3°C.
12	Grey	3.06	2.77	1.93	0.84	—	1202	1154	774
17	Grey	3.00	2.62	2.40	0.22	0.50	1210	1146	687
S.	White	Nil	—	—	—	0.50	—	—	—

The effect of the manganese in lowering the pearlite arrest temperature (H_3 deg. C.) is confirmed by these experiments. The increase in temperature range of the solidus period, that is the difference between H_1 deg. C. and H_2 deg. C., is partially to be ascribed to the lower total carbon content of this alloy. It is undoubtedly partially due to the manganese present, and, in the writer's opinion, the influence of this small quantity of manganese in increasing the extent of graphitisation is largely to be ascribed to this effect. These results amply demonstrate the fact that the influence of manganese in itself is rather to reduce the combined carbon, other things being equal. In other words, manganese has the tendency to soften rather than harden cast iron. This conclusion is, to use Coe's own words, "the disappearance of graphite with a concomitant increase in combined carbon did not appear to occur appreciably until the manganese reached 3 per cent., after which the one disappeared fairly uniformly with an equivalent increase in the latter. Even with 17.5 per cent. manganese there was a perceptible amount of free carbon present." This is at variance with the oft-expressed opinion even to-day that manganese tends to harden the cast iron, and in so far as the relative proportions of combined and free carbon are concerned with the percentages usually met with in ordinary foundry practice, this conclusion is entirely wrong, and the influence is, if anything, in the opposite direction (*i.e.*, more graphite, less combined carbon).

Hardness.

In spite of this Coe found that the hardness of the iron-carbon-silicon-manganese series, as determined by the Shore scleroscope, undergoes a change with increasing manganese content. A series of Coe's determinations up to a manganese percentage of 5 per cent. have been plotted in Fig. 1. For comparison purposes the combined carbon contents, the total shrinkage and expansion curves have been added from Coe's determinations. From these curves it will be seen at once that the distinct rise followed by a fall in the hardness values is entirely independent of the combined carbon value. The change in hardness value more nearly coincides with the change in total shrinkage value. From this observation it is legitimate to conclude that this influence of manganese is to be ascribed to a cause connected with the total shrinkage, which in its turn is probably largely influenced by the effect of manganese on the soundness of the cast iron. With our present knowledge this is the most plausible explanation of this influence of manganese on the hardness; but it is very necessary to investigate this still more completely. It is sufficient at this stage to note that increased additions of manganese bring about an increase in hardness values up to a point, but that this is independent of the combined carbon and condition of the carbon as is so often wrongly assumed.

* J.I.S.I., 1910.

Shrinkage.

The influence of increasing quantities of manganese on the total shrinkage is illustrated in Fig. 1, and its influence in increasing this value when present in ordinary commercial quantities is now fairly well known. Within the commercial limits of manganese this influence is not found to be very great.

Soundness and Fluidity.

Probably the most important influence of manganese on cast iron is its influence on the casting properties as exemplified by the fluidity of the metal and the ultimate soundness of the casting. The influence of manganese in this respect has been well known for some time, although the mechanism of this influence has not received the attention it deserves. In connection with steel the influence of manganese in promoting soundness and fluidity has been known for a long time. The success of Bessemer's process was not assured until manganese additions were resorted to.

The monumental work of Brinell on the subject of sound steel shows very clearly that this is a matter of the chemical composition, and Brinell gives a quantitative expression with curves showing the combined influence of silicon, manganese, and aluminium in promoting soundness. The relative order of the influence of these three

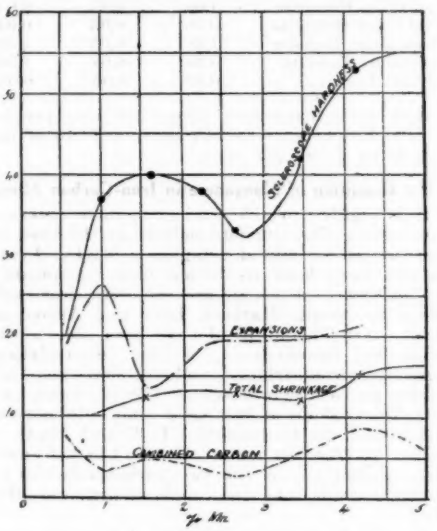


FIG. 1.

elements is as follows: Aluminium, silicon, manganese.

The conditions in cast iron are considerably different from those in steel, and the large percentages of silicon present in the former is one of the principal reasons why unsoundness of the "steel type" is not so frequently met with in cast iron. The large quantities of this element present also tend to reduce this influence, which must be allocated to the manganese from this point of view in cast iron. At the same time manganese exerts its quota of influence in this respect, and this influence, in its turn, is thought to be connected with its influence on retaining the dissolved or occluded gases in solution. The effects of manganese in lowering the temperature of the solidification point and increasing the solidification period are probably the most important factors in that by their virtue a longer time is available for the evolution of the dissolved gases. The same factors are probably also responsible for the increase in "fluidity" (this term is used in its foundry sense) noticed by the increasing addition of manganese.

This influence of manganese on soundness and fluidity is probably what is meant when manganese is referred to as a "scavenger." This is a *rôle* which is attributed to a number of other special elements when added to cast iron, and it

is probable that these in their turn really act in a similar manner.

Broadly speaking, manganese has an intrinsic influence in slightly increasing the tensile strength. This influence, together with its influence on the total shrinkage, might be accounted for in a similar manner.

Manganese has also an important influence on maintaining the strength of cast iron at moderately high temperatures and in preventing the distortion—two very desirable features in castings for internal-combustion engine work. The influence of manganese in this connection has not been fully and systematically investigated. It will probably be found that the amounts of other constituents present will be of considerable importance in determining the extent of the influence of manganese. From its influence in preventing distortion it would at once appear that the manganese exerts some influence in increasing the stability of the pearlite constituent, as it is largely due to the breaking down of this that the distortion at temperatures up to the pearlite point takes place. This influence is not necessarily contradictory to the "stable graphite-forming tendency" mentioned above. In the first place, this influence is at present only known in conjunction with low-silicon cast irons, in which it would be expected that the graphite-forming tendency of the manganese would be considerably reduced. In the second place, the breaking down of the pearlite constituent at temperatures below the Ar, point is, as far as we know, an entirely different process from the formation of graphite in the normal way at temperatures above the pearlite point.

London Branch Notes.

Owing to the continued illness of Mr. H. G. Sommerfield, the Council of the London Branch have asked Mr. H. Shillitoe to act as secretary (*pro tem.*) until such time as the honorary secretary can recommence his duties.

Mr. J. W. Gardom, of Dunstable, has been elected a member of Council in the room of Mr. Cole-Estep, who resigned on his return to America. His office as auditor has been filled by Mr. H. J. Maybury. Next Saturday the Branch pay a visit to the foundries of Messrs. Morris Motors, Limited, of Oxford.

The French Annual Congress.

M. Ronceray announced at the last Council meeting of the Association Technique de Fonderie that 30 Papers were to be presented. They included four or five on special pig-irons, four on standardisation of patterns, five on costing, seven on foundry sands, and ten of foundry troubles. It will be remembered that the Congress is to be held in Paris from November 21 to 23, and that British foundrymen are asked to co-operate.

Electric Furnace for Australia.

Mr. R. Mason, of Messrs. Mason & Cox, of Adelaide, Australia, who is at present visiting this country, has placed an order with Watsons (Metallurgists), Limited, of Lancaster Street, Sheffield, for a 1-ton Greaves-Etchell electric steel-melting furnace. Mr. Mason, it will be remembered, is a Past-President of Birmingham Branch. There will now be three Greaves-Etchell furnaces in Australian foundries.

New Chinese Ironworks.

It is proposed to establish at Chungking an iron and steel works, to be known as the Szechwan Steel and Iron Works. Mr. Chen Fung Chien, who has been trained in Germany, is to direct the construction.

Designs.

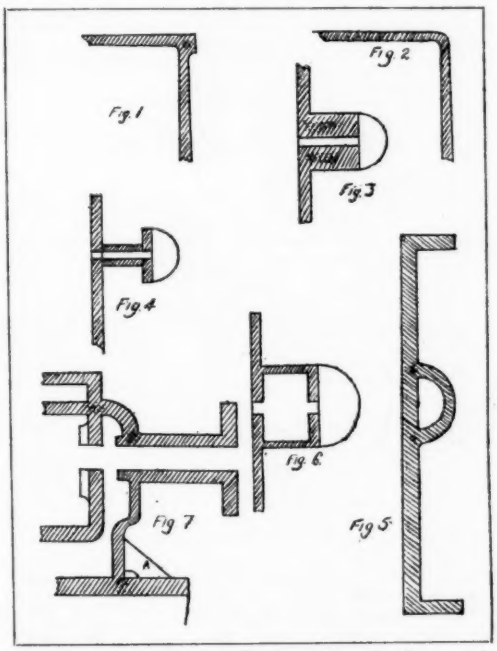
By J. E. P.

It is well known that many designs could easily be altered to reduce moulding costs and insure sounder castings.

The castings illustrated in this article have to be subjected to very high water pressure tests. Fig. 1 is part of a casting, with an ornamental bead running round the top of the casting, and for no other purpose was this bead added, than ornamentation. This was the cause of many a casting being condemned through sponginess. Although several different mixtures of metal were tried, none was quite successful. Ultimately the buyers agreed to the foundryman's suggestion to alter the design as at Fig. 2. This proved quite satisfactory, although it did not look so nice as Fig. 1.

Fig. 3 shows another bad design, which gave the foundry infinite trouble, all sorts of tricks were tried, such as internal and external chills, or denseners, were used and resulted in a certain measure of, but not complete, success. It was years before the authorities would consent to have this design altered, but when they did, and it was altered as Fig. 4, the result was very startling, and leaky castings became unknown. Fig. 6 is another method to prevent unsoundness.

Of course there are designs which cannot be altered; then the foundryman must do the best he



can, and use any artificial means to obtain a uniform rate of cooling in the castings.

Fig. 5 is a casting, the design of which cannot be altered, so chills were applied at the danger points.

Fig. 7 is another casting where the design could not be altered, so both internal and external chills were used. At A, where the strengthening bracket joins the flange and the body of the casting, a small core was placed in the corner running through the bracket. This was very effective.

Can any leaky castings be made sound? One might say there are three degrees of unsoundness in castings—sweat, weep, and leak. It is undoubtedly a short-sighted policy to allow an unintelligent person full power to condemn any casting after he has tested it and found it sweating, weeping or leaking, as it is well known that leaky castings will rust-up quite satisfactory and without the least risk of their leaking in the future.

It has been known to give a large leaky cylinder a good feed of oatmeal, then put the pressure on and force the oatmeal into the part which was leaking. The oatmeal would be imprisoned there, and after a comparatively short time would solidify; the casting would then be quite good and sound.

It is easy to throw out work, but it takes some intelligence to bring it in.

Making Propellers.—VI.

By Ben Shaw and James Edgar.

BOSS PATTERNS.

The average propeller boss is a comparatively simple pattern, yet it causes an inexperienced man some trouble. The construction is different from an ordinary square or rectangular box pattern, yet the shape does not lend itself to segmental construction. Propeller boss patterns are always heavy, even when they are made, as far as possible, skeleton. It may be asked: When is it profitable to incur the expense of a solid wood pattern instead of making a few boards for loam? In nearly all marine shops there is a stock of propeller bosses of various diameters for three- and four-bladed propellers, although it is very seldom that an old pattern can be used without considerable alterations. Much depends on the method of the foundry as to whether a full pattern is necessary. Some foundries make bosses in dry sand, while others prefer to work in loam. It is also necessary, in the case of a twin-screw ship, to make two bosses, and sometimes when sister ships are built, four bosses are required, and it is certainly profitable to make a pattern that reduces work in the foundry.

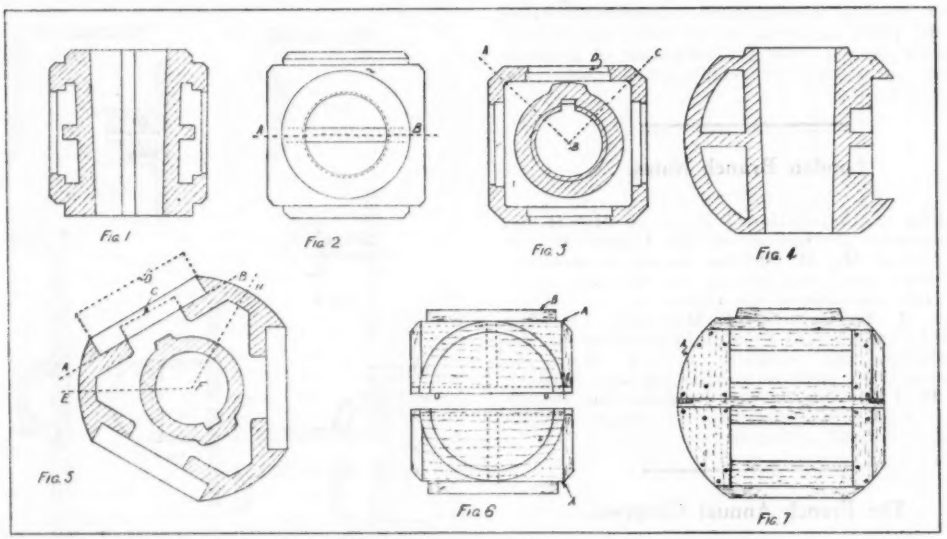


FIG. 1 FIG. 2 FIG. 3 FIG. 4

FIG. 5 FIG. 6 FIG. 7

The difficulty in construction is owing to the fact that a propeller boss is what may be described as a sphere with flats. In the case of a four-bladed propeller a more regular construction is possible than with a three-bladed propeller. Unless with very small bosses, they must be boxed up, and it is very rare that small propellers are made with separate blades. In some shops it is customary to joint the patterns across the centre line—that is, with the ends of the bosses in the top and bottom part of the mould respectively. In other shops the pattern is made solid and the moulder makes his own joint. The main advantage of making such a heavy pattern in halves is that it can be more conveniently handled while it is being constructed in the pattern shop, and it also facilitates the moulding, because there is no difficulty in finding the mould joint on the exact centre line.

Figs. 1, 2, and 3 represent a sectional elevation and a sectional plan of a four-bladed propeller. The pattern would be jointed on the line A B, Fig. 2. We shall suppose that it has been decided to make the pattern in two halves. Joint plates are necessary, and these should not be less than 1¼-in. thick. They may be either of several widths of timber, jointed edge to edge, or, what is much better, of half-lapped timber in the form of a frame. These plates should be dowelled together before they are drawn and cut to shape. The present writers have before, in the columns of this journal, emphasised the need for open joints in frame, which allows the timber to expand or contract as it absorbs or gives off moisture without warping the pattern. This is one of the important constructional points in pattern-making, which make all the difference between work being good and bad. When the plates have been cut carefully to shape, they may be placed at one side while the faces are being made. At Fig. 6 is shown a pattern in the course of construction. The face plates, four in number, of course, may be made 2 in., and sometimes more, in thickness. The thicker they are, the less blocking up of the corners is necessary to complete the sphere. These plates may be turned in the lathe, and the thickness of the joint plate afterwards sawn from them. There are several ways in which they may be held in a vertical position while the pattern is being completed, and Fig. 7 shows what we believe is the best way. A cross is formed of timber 1¼-in. or 1½-in. thick, of sufficient width to reach to the under side of the top circular plate B, and this cross, as will be seen, not only keeps the face plates vertical and rigid, but also supports effectively the top plate. At this stage it is necessary to place the two halves of the boss together and plane over the various faces. After this the corners have to be filled in, and it is necessary to remove the plate B while this is being done. Some pattern-makers are satisfied to insert one piece of timber radiating to the centre, which defines the shape exactly between the two blade flange faces, but it is really more satisfactory to fill in the whole space. For this purpose a template should be used with its edge curved to the radius of the sphere. It is possible, and not very difficult, to build a block with three square faces and draw the shape geometrically so accurately that it can be cut and almost finished before being fitted between the faces, but it is probably as easy to joint a block of several thicknesses in position, cutting each piece roughly to the shape as it is inserted. The first block is the most awkward to make. When it has been shaped with the template, it may be dissembled and the several pieces will serve as templates to make up the other seven blocks. When all the blocks have been finally screwed in position, the spokeshave may be used for finishing purposes, and the top plates again screwed on. A pattern made in this way will not yield when handled in the foundry, and will stand much rough usage.

All four-bladed propellers are not of similar design to that just described; indeed, it is sur-

prising the differences there are, arising chiefly from the idiosyncrasies of the designer, but when the pattern-maker has confidence in making one propeller boss, the modifications in construction necessary for others do not give him much concern.

With regard to core prints, these may be 2-in. to 2½-in. thick, the half-prints being sandpapered or pared square, while top and bottom prints have the usual taper. The centre core is usually made on a horizontal spindle, and the board necessary does not involve much labour. With regard to the cores on the faces, where the propeller flanges abut, a sectional corebox is necessary. A square-frame box has to be made and filled in. The bottom of this box would be shaped corresponding to the dotted lines A B C in Fig. 3. A sectional piece, corresponding to the boss centre, has to be fitted on the bottom with a key-way reinforcement piece which can be removed while three of the cores are being made. The depth of the box is to the face of the print, and filling-in pieces are necessary to form the circular core D, Fig. 3. These pieces are removed by the core-maker when making the cores. It is better, when making this corebox, that it should be slightly less rather than more than a quarter, because if more it necessitates the core-maker rubbing and fitting each core when he is putting them in place. If the corebox is carefully made and the core-maker uses ordinary care, it should scarcely be possible to detect, by examining the centre metal, where the joints have been made.

Figs. 4 and 5 represent a three-bladed propeller boss, the design of which, apart from the different number of blades, is different from the four-bladed propeller just described. From a moulding point of view the one boss is as easily made as the other, and, even in the matter of pattern construction, the three-bladed propeller does not present any exceptional problem, but the shape being more irregular, it sometimes gives the craftsman concern. Fig. 6 shows a pattern partly constructed. In this case we shall not joint the pattern, but make it solid. The centre plate may be 1¾-in. or 2-in. thick. It is profitable to make a strong frame because of the considerable weight of the pattern. The shape of the frame is obtained from the sectional plan, Fig. 5.

A decision has to be made as to whether the faces beyond the dotted line A B, Fig. 5, shall be cored out, or loose pieces made which the moulder can draw into the mould. This is important, because many pattern-makers consider that it simplifies the coring of the job somewhat if loose pieces are employed and the core print corresponds to the dotted line C, as shown, but the use of the large print D not only gives better balance when setting the cores, but gives strength to each core that would otherwise be weak owing to the presence of the central rib. The faces can be turned as previously described. In some pattern shops triangular brackets are used for supporting these faces, the top and bottom plates resting on blocks screwed to them. A better way in our opinion is to make one half-lapped frame, similar to A, Fig. 7, of about 1½-in. to 2-in. timber. This determines the spherical shape on the centre line opposite one face, and frames ought to be made which butt against the frame and determine the spherical shape between the other faces. When those three frames have been screwed into position, and the top edges carefully planed parallel with the centre plate, the top and bottom plates can be fastened into position. In a three-bladed propeller, and because of this, some pattern-makers screw one or two rings of segments behind the face plates and turn them to the spherical shape in the lathe. This may so reduce the open space that, with the centre frames, it is not considered necessary to fit additional blocks. Another recommendation of this method of building the faces is that there is less likelihood of their warping while the pattern is in the sand.

In some pattern shops, instead of the flange faces being made of one thickness of timber, they are built segmentally of two or three thicknesses, a form of construction which, of course, is always preferable to a solid plate. The top and bottom prints do not differ from those used for the four-bladed propeller, but the corebox, while essentially similar, is somewhat more confusing. If prints are used as represented by the dotted line D, Fig. 5, the internal flange must be so fitted in the corebox as to admit of its easy withdrawal by the core maker. When loose pieces are employed there is not any difficulty of this kind, but it is open to question whether the bottom or the top of the box should be made to the dotted line E F H. When this line forms the top of the box, the bottom can be easily filled in to leave the circular central core, and a loose piece, corresponding to the centre boss, held in position with a longitudinal batten.

The face prints for these bosses, when they are large, can be most conveniently made with a plate of timber on which are screwed one or two thicknesses of segments. Some moulders like these prints to be about 3-in. thick, while others are satisfied if they are 1½ in. As a matter of fact, the latter thickness ought to be sufficient, and 2 in. is a safe thickness print for a pattern-maker to send to a strange foundry. The question arises in building a propeller boss as to the best way of securing the various parts. It is not a question of vital importance, perhaps, but it is worthy of brief consideration. Pocket screws, sometimes called cheek screws, are often used, but buttons or blocks, about 1¼-in. square, are more satisfactory.

There is no need for the pattern-maker's attendance in the foundry while a propeller boss is being made. The job is a fairly straightforward one from a moulder's point of view, and if given a rigid pattern of accurate measurements, and with a suitable corebox, there is seldom any difficulty in obtaining a good casting.

Catalogues Received.

Heat Treatment of Steel.—We have received from Automatic and Electric Furnaces, Limited, of 173, Farringdon Road, Heat Treatment Bulletin No. 33, which outlines some tests made on time taken for steel sections to reach furnace temperatures.

Electric Light Fittings.—We have received from the Engineering & Lighting Equipment Company, Limited, of Sphere Works, St. Albans, a 45-page catalogue describing the fittings they manufacture for street and works lighting.

Welding Repairs. — Barimar, Limited, have issued a booklet bearing the title "Send to Barimar." It details the service they give for the welding of broken metallic parts.

Electrical Supplies.—Donovan & Company, 47, Cornwall Street, Birmingham, are circularising the trade with a 20-page catalogue and price list appertaining to the electrical supplies they handle.

Foundry Products. —We have received from James & Fredk. Howard, Limited, of Britannia Iron Works, Bedford, a beautiful illustrated catalogue describing their diverse manufactures, which include machines for agriculture, power cultivation, abbattoir equipment, presses, portable railways, and malleable castings. Whoever is responsible for its get up is to be congratulated, for it is rare that one finds the balance between "personal contact" and the display of typical manufactures so nicely effected.

From the foundry point of view, and knowing as we do that the firm has excellent foundry buildings equipped on the best lines, we suggest that a picture, or even several pictures, could usefully have been incorporated. The catalogue is bound in an imitation leather, and is two-colour printed on art paper. It contains 128 well-illustrated art pages.

Cast Iron Pipes, the monthly stock list for November, issued by the Staveley Coal & Iron Company, Chesterfield, is now available.

Canada and Belgium.—A Reuter's cable from Ottawa states that formal ratifications of the Commercial Treaty between Canada and Belgium giving the most-favoured-nation rates were formally exchanged on October 22 by the Acting Minister of Finance signing for Canada and the Consul-General for Belgium. The new preferential rates become effective immediately.

American Foundrymen's Association.

Report of Committee on Grey Iron Castings.

Abstract.

Your committee on grey iron submits the following report of its activities during the year 1923-1924 for your approval:—

(3) On May 2, 1923, your committee resolved to hold a meeting at the Hotel Gibson, Cincinnati, Ohio, some time between that date and the time of the convention of the American Society for Testing Materials in Atlantic City in June. This meeting was to be primarily for discussing the adoption of an International Test bar. The committee assembled at the Statler Hotel, Detroit, Michigan, on December 15, 1923.

(4) The members present were:—H. B. Swan (Chairman), Cadillac Motor Car Company; E. J. Lowry (Secretary), Hickman, Williams & Company; R. S. MacPherran, Allis-Chambers Manufacturing Corporation; Willard Rother, Buffalo Foundry & Machine Company; J. D. Stoddard, Detroit Testing Laboratories; H. E. Diller, Penton Publishing Company.

Visitors (Members of the A.S.T.M. Committee A-4):—Dr. Richard Moldenke, Watchung, N.J.; Walter Wood, R. D. Wood & Company.

Members Absent:—Jesse Jones, Westinghouse Electric & Manufacturing Company; George Elliott, Lunkenheimer Company.

(5) On the international test bar committee are representatives from eight countries—the United States, Great Britain, France, Spain, Italy, Belgium, Switzerland and Czecho-Slovakia. E. Ramas, of France, is chairman, and E. Ronceray, of Paris, is the secretary. H. B. Swan is the American member.

It was decided at the Detroit meeting that the lines of inquiry preliminary to the selection of an international arbitration bar include (1) the relation of different sizes and shapes of test bars to be used in determining the quality of the iron in the ladle, and (2) the relation of the test bar to the casting.

The committee recommended that preference be given the transverse test in the investigations that are to be made. It was decided also to investigate a shrinkage chill test bar invented by Mr. Lowry.

The procedure which the committee recommends to foundries participating in its work is stated as follows:—

(*a*) Experimental work shall be done on round test bars. The diameters of the test bars to be considered shall be 1.2, 1.3, 1.4 and 1.5 ins. The bars shall be cast on end, one to a mould, 21 ins. long and shall be tested on 18-in. centres. The design of the bar shall be similar to the present A.S.T.M. bar with the alteration in dimensions noted above. The moulds shall be either made of dry sand or cores. The test bars shall not be tumbled or machined, and in case of shipment over railways to a point where they may be tested, the test bars shall be packed in sawdust or some similar material.

(*b*) There shall be at least twelve bars of each diameter cast from a heat and these bars shall be cast from the same ladle. Six of the bars shall be tested by the maker and the remaining six bars shall be sent to the committee, care of E. J. Lowry, secretary, Chicago, for supplementary tests. The analysis of the sets of test bars shall be sent to the committee along with the results of the individual foundry strength tests. The analysis should cover carbons, silicon, sulphur, phosphorus and manganese.

(*c*) The test bars shall be numbered from 1 to 12 and in such a way that their identity may not be destroyed, *i.e.*, such as the heat number and maker's mark.

(*d*) In order to effect knowledge of the British method of testing, the following shall be pursued: Test bars, 12 in number, moulded singly on end, in dry sand, or core moulds, shall be made by individual foundries. These bars shall have the following dimensions: 0.875 in. dia., 15 ins. long, 1.2 in. dia., 21 ins. long and 2.2 ins. dia., 21 ins. long.

(*e*) These bars shall be tested in accordance with the plan set forth above. The 0.875-in. bar shall represent castings up to ¾-in. section; the 1.2-in. bar, up to 2 in. section castings, and the 2.2-in. bar, above 2 in. section castings. These bars shall be tested on supports 12 ins. and 18 ins. apart.

(*f*) Factors shall be determined to correlate these various diameter test bars to the 1.2 in. dia. strength.

(6) As a result of the Detroit meeting, the following members made up their test bars in accordance with the specification noted in section No. 5 of this report: Walter Wood, R. D. Wood & Company; Willard Rother, Buffalo Foundry and Machine Company; H. B. Swan, Cadillac Motor Car Company; R. S. MacPherran, Allis-Chambers Manufacturing Corporation. Dr. Moldenke kindly favoured us with his efforts in breaking and assembling data on the R. D. Wood & Company's test bars. Dr. Moldenke's work was most sincerely appreciated by the committee.

(7) The results of all the tests were sent to the secretary of the committee, who transmitted the complete sets of figures to the committee members for their opinions.

(8) A copy of the results are attached as Appendix A.

(9) As a result of the letter of July 24, 1924, by letter vote the 1.2 in. dia. test bar by 18 ins. long was adopted. The vote was unanimous for the 1.2 in. bar to represent "the character of the metal in the ladle from which it was poured and not to be representative of the castings made from the ladle of iron."

(11) The committee still has before it the investigation of the Fremont Portevin method of testing cast iron. This should be completed in the near future. The machine is now in the hands of H. B. Swan, who is performing one series of tests with it at the present time.

The Report is signed by E. J. Lowry, its secretary, and is approved by H. B. Swan, its chairman.

In the appendix Mr. Lowry states that after several weeks of study and analysis of the facts submitted, his conclusions are that either the 1.2 or the 1.3 in. dia. test bars are acceptable to the foundry trade at large. The 0.875 in. is too small for any accurate results. The 1.4, 1.5 and 2.2 in. bars are too heavy for the average testing machine. This is especially true with the 2.2 in., which requires practically 15,000 pounds to break it. There is, further, a question of good castings in comparison to the weight of these bars.

He had found that the 0.875 in. dia. gives but 33⅓ per cent. good castings, while the 1.2 in. gives 59⅓ per cent.; the 1.3 in. gives 54.1 per cent. good castings; the 1.4 in. gives 60 4-5 per cent.; and the 1.5 in., 75 per cent.

The factor of good castings is essential to the foundryman in producing test bars, because he ordinarily casts but one set, and should these be flawed, he would lose the opportunity of establishing a record for his heat.

The 0.875 in. bar gave a very erratic deflection curve; the 1.2 and the 1.3 in. bars gave a very good deflection; the 1.4, 1.5 and 2.2 in. bars gave good deflection curves, but the factor of the load required to break them places them out of consideration.

The appendix contains seven tables detailing the figures obtained by four well-known American foundries.

Table I refers to tests obtained by the Cadillac Motor Company. The material used contained from 2.93 to 3.20 graphite, 0.41 to 0.47 combined carbon, 0.41 to 0.71 manganese, 0.077 to 0.099 sulphur, 2.04 to 2.47 silicon, and 0.17 to 0.25 per cent. phosphorus. Bars of 0.875, 1.2, 1.3, 1.4, 1.5 and 2.2 in. dia. were tested transversely, at 18 in. centres, except the smallest, which was between 12 in. centres. When calculated to the A.T.S.M. 1¼-in. bar, the averages of six of each size, starting with the smallest, gave 3,766, 3,060, 3,588, 3,525, 3,000, 3,226 lbs.

Tables II and III are the figures supplied by the Allis-Chambers Manufacturing Company. Two irons were used, one containing T.C., 3.43; Si, 1.43; S, 0.131; P, 0.43; and Mn, 0.48 per cent; and the other T.C., 3.48; Si, 1.91; S, 0.093; P, 0.58; and Mn, 0.47.

There were no tests on bars S (0.875 in.) and L (2.2 in.) of the I.B.F. proposed bars. An average of five M (1.2 in.) bars of the first composition, tested at 18 in. centres, gave 2,526 lbs., and six of the second 1,994 lbs. Table IV outlines the results obtained by Buffalo Foundry & Machine Company, who have carried out between six and nine tests on bars of 0.875 (British S), 1.20 (British M), 1.30, 1.40 and 1.50 in. dia. (British L). The material used contained T.C., 3.20; Si, 1.50; Mn, 0.80; S, 0.08; and P, 0.24 per cent. Bar S averaged 1,007; Bar M, 1,595; and Bar L, 8,763 lbs. Bar S was tested at 12 in. centres, and Bars M and L at 18 in. between supports.

The work of R. D. Wood & Company is detailed in Tables V, VI, VII. For the British bars the composition were:—*Cast No.* 3: T.C., 3.49; Gr, 2.99; C.C., 0.50; Si, 1.74; Mn, 0.41; S, 0.115; and P, 0.75 per cent. *Cast No.* 4: T.C., 3.66; Gr, 3.05; C.C., 0.61; Si, 2.12; Mn, 0.57; S, 0.090; and P, 0.63 per cent. *Cast No.* 6: T.C., 3.16; Gr. C., 2.63; C.C., 0.53; Si, 2.76; Mn, 0.76; S, 0.068; and P, 0.59 per cent.

Bar S was tested at 18 in. centres, and six bars gave an average transverse strength of 794 lbs. associated with 0.214 in. deflection. For Bar M the average was for the compositions stated 1,827 lbs., associated with 0.179 ins. deflection. Bar L broke on an average at 10,821 lbs. with 0.139 in. deflection.

DISCUSSION.

MR. JOHN SHAW (Sheffield) has communicated the following discussion to the American Foundrymen's Association:—

As a member of the A.F.A. and Chairman of the I.B.F. Committee on Physical Tests for Cast Iron, it was with the greatest interest I read the report of the A.F.A. Committee on Grey Iron Castings. Before dealing with the figures and conclusions given, it seems opportune to enumerate two fundamental principles that govern this question.

First. That any cast iron is at its strongest when it contains 0.7 to 1.00 per cent. C.C. This does not mean that two irons containing, say, 0.8 per cent. C.C. will be equal in strength, but it does mean that if one casts three bars of, say, 1, 2 and 4 in. dia. from the same ladle of metal, the one that nearest approaches the 0.9 per cent. C.C. will be the strongest.

Second. That it is quite possible to obtain this strongest structure in any one of the above bars by composition and the cooling action on the varying mass. That is, with one composition, casting these three bars 1, 2 and 4 in. dia, in dry sand moulds cast vertically, it is possible to have 0.9 per cent. C.C. in the 1-in. bar, while the C.C. in the 4-in. may be down to 0.2 per cent. On the other hand, from another composition the 1-in. bar will contain 3 per cent. C.C. and be white, while the 4 in. will not contain over 0.8 per cent. C.C.

The above facts will be admitted at once, even by those persistent advocates of the one size bar, Dr. Moldenke and Mr. Wood.

Now let us examine the evidence put before the Committee to help them to come to the conclusions they did, which affects the 5,000 grey iron foundries in North America. Four returns only are made. There is one point that needs explanation. Are we to understand that the analyses given are the calculated analyses before casting, or the actual analyses in the bar, or is the analysis taken from a separate cast test piece? The report from the Cadillac Motor Company is by far the most clear and the resultant tests in each case excellent. Nearly every bar is above the test required, the greatest C.C. of 0.49 per cent. giving the highest result.

The Allis-Chambers Company.—This Company have made no effort to try out either the 0.875 bar or the large 2.2 dia. bar, but have contented themselves with the four sizes asked for by the American Committee. They have evidently used two stock mixtures for medium castings. The first is evidently about right for all the bars, while the second appears to be on the soft side for the larger bars, because there is a regular drop from the 1.2 dia. bar. No attempt has been made to discriminate between a mixture for castings, say, ½ in. average thickness and those, say, 3 in. thick, such as Diesel liners.

The report from the Buffalo Foundry Company is difficult to understand. Why anyone should put iron containing 1.5 Si and 3.2 T.C. into castings ½ in. thick and others where no thickness is less than 2 in. is a mystery. The test results are also peculiar. One would naturally expect the 0.875 bar to fail because it would be too hard, but why the results of the 2.2 dia. bar should be too low is hard to explain, especially when compared with the Cadillac and Wood results with their softer mixture.

Coming now to Dr. Moldenke and Mr. Wood's return, one is surprised that two foundrymen of their experience put forward the three mixtures of iron they tabulate and expect to get comparable results in strength in castings ½ in. thick, and at the other extreme castings 3½ in. thick, say hydraulic cylinders. Can they possibly get a decent strength in the cylinder with any of the three irons set forth? It would appear to a cynical observer that their main object was to have one dia. of test bar, obtain a suitable mixture, and let the casting find its level. In short, make a good test bar. Let us compare the evidence on which we are asked to accept one size of bar—

Metal suitable for casting ½-in. thick.

	T.C.	G.C.	C.C.	Mn.	S.	Si.	P.
Cadillac Motor/	3.42	2.93	0.49	0.69	0.08	2.47	0.17
Buffalo Foundry	3.20	—	—	0.80	0.08	1.5	0.24
Wood	3.49	2.99	0.50	0.41	0.115	1.74	0.75
,,	3.66	3.05	0.61	0.57	0.09	2.12	0.63
,,	3.16	2.63	0.53	0.76	0.068	2.76	0.59

That is, a variation of Si of 1.5 to 2.76 per cent.

Take next the medium casting in which no main cross section is less than ¾ in. or more than 2 in. thick:—

	T.C.	G.C.	C.C.	Mn.	S.	Si.	P.
Cadillac Motor	3.61	3.2	0.41	0.71	0.094	2.28	0.21
Allis-Chambers	3.43	—	—	0.48	0.131	1.43	0.43
,, ,,	3.48	—	—	0.47	0.093	1.91	0.58
Buffalo Fdry	3.20	—	—	0.80	0.080	1.50	0.24
Wood	3.49	2.99	0.50	0.41	0.115	1.74	0.75
,,	3.66	3.05	0.61	0.57	0.09	2.12	0.63
,,	3.16	2.63	0.53	0.76	0.068	2.76	0.59

A variation in silicon of 1.43 to 2.76 per cent.

For castings in which no main cross section is less than 2 in., the following compositions were put forward as suitable:—

	T.C.	G.C.	C.C.	Mn.	S.	Si.	P.
Cadillac Motor	3.46	3.02	0.44	0.46	0.079	2.04	0.2
Buffalo Fdry	3.20	—	—	0.80	0.08	1.50	0.24
Wood	3.49	2.99	0.50	0.41	0.115	1.74	0.75
,,	3.66	3.05	0.61	0.57	0.090	2.12	0.63
,,	3.16	2.63	0.53	0.76	0.068	2.76	0.59

Now I think a study of the mixtures given above will convince any practical man that at least some of them are not suitable for the thickness of casting they would be required for, judged by the size of the bar into which they were cast. We in this country believe that the mixture should suit the casting and not the bar. It is because we find it impossible to do this and use any one size bar that the three sizes of bar were adopted. In fact, in the minds of some members this was not far enough, but practical considerations forbid further sub-divisions.

I have just read through the history of the American bar since the year 1893. I find that man of vision, the late Thos. D. West, was the first to advocate the round bar. He also states in 1897: "All founders should labour to the end of inaugurating a standard system of tests, and for which the writer advocates round bars having areas equal to 1, 2, and 3 sq. in., the latter for use in hard metal, the former in soft iron."

I could quote name after name who have held this view, and the fact that the Government included a 3-in. bar in their specification, but made the mistake of turning it down to 1.129 in. dia., to meet the testing machines for tensile, and so leaving the soft centre.

Dr. Howe held this view. Prof. Porter stated in October, 1912: "In the testing of strength it must be remembered that the purposes of cast

iron depend in part upon the thickness of the section, and hence that in cases where it is not possible to test the casting itself, *the test piece should at least approximate the section of the casting.* Probably three standard sizes of test bars could be selected, to represent the three classes of light, medium, and thick castings." The last quotation in this respect is the Paper delivered before this year's Convention by Mr. Bolton, in which he states that, other things being equal, cast iron is at its strongest when the C.C. is between 0.7 to 1 per cent. That with increased C.C. its strength falls away rapidly. With the lowering of the C.C. below the points named its strength falls to a minimum.

Turning now to the mechanical objections, your Secretary states the 0.875 is too small for any accurate results. I think if he will compare these results to the 1.2-in. size of the bar he will find just about the same variation. It must also be remembered that in the Wood results the bar was tested at 18-in. centres and not 12 in. as per specification. It is also stated that the 0.875 gave 66 per cent. bad castings. Well, in this country we should not have wanted a new size of bar, but a new foreman. The funny thing about it is that a committee* on tests took just the same line about the present bar when first introduced by West in 1894. "A lengthy discussion took place between several of the gentlemen present on the points brought out by the report of the Committee. The strongly adverse decision against round test bars, for which so much had been claimed, etc." Table No. 1 showed 55½ per cent. bad, No. 3 series showed 43 per cent. bad, while all the square bars were perfect, etc. So there is still hope you will be able to make a ⅞ round bar 15 in. long without flaws.

A comparison of the deflections on the 0.875-in. bar shows no more variation than the 1.2-in. dia. bar.

"The 2.2-in. bar gave good results and good deflection curves, but the factor of the load required to break them places them out of consideration." So the testing machine is of more importance than the casting. The British say, scrap the machine and know the strength of the metal best suited for the thick casting. I think it is already proved one cannot get good test bars 1.2-in. dia. and the strongest castings in the thick castings.

I will finish with a quotation from Dr. Moldenke, with which we on this side are in complete agreement: "Primarily the test bar is to show its maker what information can be obtained in regard to the physical quality of the material he has cast. In other words, his product is already complete, but he has to some extent a safeguard which will enable him to ship his work with an easy conscience, or scrap it if not up to requirements. Secondly, the test bar serves as a fund of information, the careful study of which is of great value to the founder in subsequent work. *In both cases just mentioned the test bar should approach the leading dimensions of the work,* or, better still, be cut directly out of a casting rejected."

A New Junior Section for Foundrymen Formed.

The Lancashire Branch of the Institute of British Foundrymen have organised a junior section, with the object of interesting foundry apprentices, journeymen moulders, and pattern-makers, young metallurgical chemists in aspects of their craft with which they are but partially familiar. Meetings are to be held in the Manchester College of Technology on Saturday evenings at 7 p.m. The organisers, Mr. R. A. Miles and Mr. Tom Makemson, the local President and Secretary, are to be congratulated on the excellent start they have given to the juniors.

A series of six lectures have been arranged, and Papers have been promised by such well-known foundrymen as W. H. Sherburn (Warrington), F. W. Rowe, B.Sc. (Huddersfield), J. G. Robinson (Halifax), W. H. Meadowcroft (Tyldesley), H. Stead (Stalybridge), and A. Hill (Heywood). The programme includes a number of visits to representative works.

*Western Foundrymen's Association.

Inspection and Annealing.

Stressing the importance of careful inspection and of annealing as the best ways to avoid defective material, Colonel James Milliken, President Pittsburgh Testing Laboratory, Pittsburgh, gave several interesting examples in a talk before the Pittsburgh Foundrymen's Association, at its regular monthly dinner and meeting at the General Forbes Hotel, Pittsburgh, October 20. Colonel Milliken, whose subject was "Is Inspection an Evil or a Blessing?" said in part:

In examining materials, defects are found, some of them serious in their nature, which represent an effort to cover up a condition which could not fail to bring rejection. I believe the greater number of cases of this kind occur more from a desire of an individual to shield himself from the criticism of his department head, or from ignorance of what the defect may mean when the piece of material is placed in service, than from any desire to really place defective material on the market or to be dishonest.

In complicated steel castings, shrinkage cracks are the principal trouble with which the inspector has to contend. There are many causes for these. Sometimes they are due to design. Many castings are designed by persons with little experience in pattern making or foundry practice. A great many shrinkage cracks, however, are caused by failure to carefully and properly anneal. Many losses occur due to the "penny wise and pound foolish" idea of trying to save money on the annealing, with results which are sometimes quite serious.

I have in mind a case of a large flywheel which was to be run at high speed and which burst while undergoing an over-speed test. An examination of the débris disclosed the fact that some of the spokes had been cracked clear across in the original making. Someone in the shop had attempted to repair the spokes, or to cover up the cracks by chipping out the edges and filling in with welding material, chipping and filing the surface smooth, and re-annealing the casting, giving it such a nice smooth, blue, hard scale covering that no one could see the hidden defects. No one saw these defects but the foundrymen. Inspectors could not see them because they had been deliberately hidden. A new scale had been developed by the second annealing. It had most serious results, for in its breaking one man was killed and three others badly hurt. If this casting had been properly annealed in the first place it is doubtful if the cracks would ever have developed. The right kind of inspection in this foundry in the early stages would have prevented an attempt to repair a casting in which the strength of its component parts was vital.

Taking at random from our records, 10 recent orders of cast-iron pipe we inspected, manufactured at seven different foundries, in large sizes, there were 7,353 tons manufactured and turned over to us to inspect. Of this lot, 1,029 tons, or approximately 14 per cent., was rejected. This does not take into account a certain tonnage rejected by the manufacturer in advance of our inspection.

Among the causes for rejection on this lot of pipe were core scabs, cracks and cuts, crushed sockets, cut head, scab head, mould strain, mould cuts, improper ramming, blacking cuts and holes, dirt hole, scale, cold shuts and defective beads, all preventable and caused mainly by carelessness in the making, drying, handling or placing of cores, or in pouring. If careful control of the product by both chemical and physical tests was not a good investment it would not be continued. In other words, improving the product cuts down the manufacturing loss.

More care in the supervision of the handling of cores, not only in the making, but in the drying and placing; and also more supervision of the pouring of the metal, would annually save the foundry business many thousands of dollars.—*Iron Age* Report.

THE ENGINEERING department of the Rochsolloch Ironworks, Airdrie, of the Scottish Iron & Steel Company, Limited, was badly damaged by fire last week.

Institute of British Foundrymen.

NEWCASTLE BRANCH.

At the October meeting of the Branch, at which Mr. J. W. Frier presided, MR. C. H. BROWN, of Gateshead, read his Paper on "Green Sand Moulding," which Paper appeared in THE FOUNDRY TRADE JOURNAL dated April 10, 1924 (Vol. 29, No. 399).

DISCUSSION.

In inviting discussion, THE PRESIDENT said he thought it was the duty of the members, having heard a practical Paper, to say where their opinions differed from those of the lecturer.

Green sand moulding, he thought, was almost one of the lost arts in foundry work. When passing through Darlington Station a week or so ago, a friend had pointed out some marvellous columns, which he said were made in green sand about 40 years ago, being cast at the rate of one per day. He (the President) wondered how this figure would compare with the present-day output of that class of casting. Everyone had his own opinion about green sand moulding, and it was interesting to hear the different ideas. In the foundry with which he was connected they did not do much of it. He remembered that when he was serving his time they used to give green sand moulds a ram with their foot first, which method prevented the pattern from being struck by the rammer, and, consequently, did away with much scabbing and buckling, and also, he thought it was possible to get sounder ramming. He considered that M. Ronceray's method of ramming up a small stick in corners of places where it was difficult to get the vent wire, and filling it up with fine ashes, was a very good one.

In the days of his apprenticeship a long knitting needle formed part of their kit. They used to pay for these themselves, and everybody had one, but things had changed since then, and if the firm did not provide the moulder with one he did without.

With regard to the pouring of castings, he quite agreed with Mr. Brown that large gates, especially in the case of castings which had to be machined, were a mistake. They had tried them, and, after hearing M. Ronceray, they had tried his system of small gates, which were successful in some cases but not in others. Leading on from that, they tried putting a number of spray gates on the joint, and as a result got cleaner castings. There were no signs of the draw holes they had had before, and, consequently, it was decided that small gates for pouring castings were superior to large ones.

Burning-On.

Mr. Brown had touched upon the "burning-on" of castings, but he (Mr. Frier) thought that perhaps he should not have done so when engineers were present. He himself had "burned-on" many castings, among them being some very large ones. He had once "burned-on" a cylinder which was condemned because, when turning it over in the machine shop, it was broken, and they found a split right through the joint flange. The burn was successful, and it saved a new casting. He might mention that this was during the war.

He would like to ask if Mr. Brown had ever been able to "burn-on" the body of a valve or a pipe successfully, because it was a thing which he had never been able to do, his difficulty being that the burn contracted away from the rest of the metal when cold.

Also Mr. Brown had spoken about the "burning-on" of cylinder steam ports, and he would like to know what size of cylinder the lecturer was referring to.

MR. J. D. NICHOLSON said there was no doubt that green sand moulding was very intricate and required a great deal of care, and although, of course, the different varieties of sand moulding all needed that care, the green sand moulder undoubtedly had to use his initiative much more than the man engaged in any other kind of moulding.

He did not think that nowadays people troubled about what distance the rammer was from the pattern, the main idea being to ram it up and get it out as quickly as possible. When preparing a hole in the floor it was best to dig it a good deal deeper than the pattern, and, by ramming with the foot, the venting of the mould was greatly assisted.

Care of Grates.

He thought that grates should be properly cleaned every time. There was a tendency to use too much clay wash, which did a great deal of harm, especially in the case of a grate on the face of the mould. He would like to know whether the lecturer thought there was a right and wrong way of putting on grates. There was a great deal of harm done through putting a grate flat side upon the face of the mould, owing to the bottom piece of sand having a great deal of clay wash amongst it. Being overburdened with clay, the heat from the iron caused it to peel away, resulting in a scab. Scabbing seemed to be the worst enemy of the green-sand moulder.

They had all read at some time or other something about fast pouring, but he had not seen a case yet where it paid to run a casting in jobbing work as quickly as possible, even if it was vented very well. He had always found that if the casting was not run too quickly the gases were allowed to escape.

He did not think that blowing, mentioned by Mr. Brown, was caused through gases from the cores, but by gases and steam from the mould not escaping sufficiently quickly.

MR. M. E. GALLON said he was wondering if Mr. Brown was able to "burn-on" castings successfully every time. He was quite satisfied that it could be done occasionally, but he was not convinced that it could be done in every case. For instance, a member had told them some years ago about successfully burning a cylinder which had a hole in the top, but Mr. Smith had said at the time that the flaw in the casting would be there, whether it could be seen or not. The outside of the hole was solid, whilst the inside was liquid metal, and it was obvious that directly the liquid metal set it would start to contract away from the metal round the hole. Therefore, there would always be a fault there, and although the casting might be commercially successful, scientifically it was not perfect.

He strongly disagreed with ramming close to the pattern, and always tried to impress upon moulders the importance of keeping their rammer off the pattern to ensure getting a good sound casting. Ramming too near the pattern caused the casting to be either buckled or scabbed, and he always told the men that they were to go no nearer than at least 1 in., because he found that if the majority of moulders were told that they could go within ½ in. they would most likely strike the pattern. Nowadays there did not seem to be the enthusiasm among moulders that there used to be, and they were inclined to think that anything would do, but, to be a craftsman, a man must put thought into his work. He had in his mind one instance of scabbing caused through ramming too near the pattern. A man was making a series of castings for America, and in one of them had his rammer too near the pattern. That casting was the only bad one, which proved that ramming had to be done very carefully.

Bedding-In Patterns.

He agreed with the lecturer that it was as well to make the hole in the floor at least twice the depth of the pattern, because if there was about 6 in. of fairly sound, but not too hard, sand under the pattern it would give the gases a chance to escape.

MR. J. D. CARMICHAEL said that, unfortunately, at their firm they were doing nothing else but green sand moulding at present, owing to trade conditions.

In the first instance he would like to criticise Mr. Brown's statement about "burning-on" a hole in a pipe, his own experience being that it was expansion during the process of burning, and not contraction, which caused the crack. It was quite easy to "burn-on," say, the tip of a propeller blade, but he had very grave doubts about

the success of "burning-on" a casting such as a pipe.

He knew of a foundry where some of the moulders used nothing else but their feet for ramming and a shovel to remove surplus sand. Speaking of rain-water pipes, he thought that there were not many men belonging to that district who could make rain-water pipes successfully.

He agreed that green-sand moulding was, or almost was, a lost art. It had been discarded, or rather lost, because of the safer methods adopted at the present day. He would compare a green-sand moulder with a pastry-baker and a dry-sand moulder with a bread-baker. A bread-baker could not make good pastry, because his hand was too heavy, and, for the same reason, the dry-sand moulder could not make a green-sand mould. In other words, the green-sand moulder had a lighter touch than the dry-sand moulder.

Speaking of the gating of a mould, he said he could not understand an intelligent man not exercising the same care in gating his mould as in preparing it, because any care was thus lost.

He had been told that it was advantageous to run cylinders as quickly as possible. He personally would not adopt that method except for very thin castings.

Present Position of Green-Sand Moulding.

MR. JAMES SMITH said that in his opinion there were not two green-sand moulders alike. When a boy started green-sand moulding he gradually worked himself up to a point where he thought he knew as much about that sand as the man who had been on the work twice as long. Consequently, each moulder worked on a method of his own, and thought he was getting the best results from his workmanship, whether he was or not.

It had been suggested that some people thought green sand moulding was dying out, but this was not the case. It might be true to say that it was dying out in districts where dry sand and green sand moulding were done in the same foundry. Everyone knew that if there was dry sand moulding in one part of the foundry and green sand in another the green sand finally became as hard as the dry sand, but in a foundry which did only green sand moulding one would find some real first-class work. There were dozens of these foundries at the present day getting as good results as ever, because their men had been trained as green-sand moulders, but it was unreasonable to expect that a man working in a foundry which did both kinds of work would be able to make a perfect green sand mould. It did not matter how many sprays were used, so long as the casting was run properly.

Burning-On Pipes.

MR. C. W. H. HOLMES said he had been exceedingly interested in the Paper and in the discussion, and he had learned something from them. He had had no idea how very difficult it was to burn a pipe, although at their firm they burnt-on quite a number of them, with the result that they had gone closely into the question, and did the job very well. He did not say every pipe that was burned-on was successful, because this was not the case. The pipes he was speaking of were from ¼ to ⅜ in. thick, and the method generally adopted was not to use a loam cake, but simply to fill the pipe with green sand, leaving perhaps ½ or 1 in. round the small blow hole in the top of the pipe, and to pour in some metal from a shank. When the man who was burning-on the pipe decided that it had had enough metal, he would push the shank away and wipe the molten metal over with a hot skimmer. The pipe was then turned over so that the burn rested in a pool of hot metal, where it was allowed to remain for the night. The cases where the burns were not successful were where the pipe was thick on one side and thin on the other, and he was inclined to think that the composition of the metal had a good deal to do with it. In casting thin pipes in green sand moulds the metal was run in as quickly as possible. Soft iron had to be used for this purpose, because if the metal was inclined to be hard there was more difficulty in burning, as there was a great tendency for the pipe to split.

He did not know of any great difficulty in burning pipes of this nature, and the fact remained that they were burned successfully in dry sand as well as green sand work. In thicker work, such as large flange pipes, burning-on was certainly very often a gamble, but, by adopting the same procedure each time, he thought there was a very fair chance of success. He thought that burning the steam-port of a cylinder was probably one of the most intricate jobs from the point of view of contraction, and possibly buckling.

Loose Nomenclature.

MR. H. J. YOUNG, F.I.C., said he was impressed always by the fact that when a moulder was talking to moulders each party invariably congratulated the other upon the lucid and definite nature of their language and descriptions. For instance, the lecturer had answered a query as to whether a casting should by poured quickly by replying "Moderately so"; and a member of the audience, when challenged by the lecturer as to whether another casting should be poured slowly, had said "Moderately so." The scientific man could be equally simple in his language, and, in order to illustrate the point, let them imagine an engineer coming to him (Mr. Young) and asking whether it would be safe to go to sea in a boat where the engines included a cylinder with its steam-port "burned" in the manner claimed by the lecturer, in which case he (Mr. Young) would reply "Moderately so." (Applause.)

MR. F. HUDSON said he would like to ask a question from the scientific point of view. With regard to the ramming of a mould, they were allowed to go within half an inch of the pattern, and it appeared from the discussion that if the pattern was struck the result would be a hard spot in the mould on which the metal would not lie quietly. In other words, as the lecturer had pointed out, if the mould was rammed too hard the metal would blow. He understood that the trouble was through the sand not being permeable enough to allow the gases to escape, and he wondered, therefore, if there was not a synthetic sand which would retain an open vent, no matter how hard it was rammed.

MR. F. ALLEN said that Runcorn sand answered that purpose. It could not be rammed too hard, and for light work it was just as good.

The Author's Reply.

In reply to Mr. Frier, with regard to burning the body of a valve or pipe, he thought that this could be accomplished successfully if it was made up with a little loam cake. He had done it himself many times to withstand the water pressure successfully. The inside of the pipe was filled with sand, put on the fire, and the metal poured in from a small shank. He had never found any difficulty with it, but, of course, much might depend upon the metal used. When he had spoken about the burning on cylinder steam ports he was referring to 12- or 13-in. bore cylinders.

With regard to Mr. Nicholson's remarks about the ramming of a mould, the lecturer said that when he was an apprentice it was impressed upon him to keep his rammer about 2 in. off the pattern, but when he gained experience he found this to be unnecessary, and now made a practice of ramming to about ½ in. off the pattern.

With regard to grates, he (the lecturer) put the flat side down only on parts not to be machined, and he always did this with good results. Some people were in the habit of dipping the grate into the clay wash, but he did not agree with that method. He believed in putting a little clay wash on with a brush, so that there would not be too much next to the mould. He did not think that it mattered which way the grate was put on, so long as too much clay wash was not used, but he generally kept the grate away from that part which had to be machined.

He did not think that green sand moulding was dying out. He happened to have been in a large foundry in Lancashire recently, where marine columns and also bedplates up to 5 or 6 tons were being made in green sand. They used a blow lamp, which did away with the old practice of using fires.

In reply to Mr. Gallon, he said that he did not think there was a great deal of difference between ramming to 1 in. off the pattern and ½ in. as he himself had suggested. He quite agreed that ramming too hard would cause scabbing, but a lot depended upon which way the rammer was used.

Some people used the head of the rammer, but he preferred to use the narrow end. He thought by ramming to ½ in. off the pattern they would not go far wrong.

With regard to the burning-on of castings, he quite agreed that they were not all successful, because it depended on which part of the casting the burn had to be made. He was glad that Mr. Gallon agreed with him about digging the pit for the mould twice as deep as the pattern. He found that it was quite sound enough to resist the pressure of metal and left the face of the mould quite open for the escape of gases.

In reply to Mr. Hudson, he said that at the present time they were using a very open Manchester sand, and they found that it blended with the plumbago better than a yellow loam. The red sand was so open that they had to mill it a little in order to give it the necessary grip like jobbing sand and yellow loam.

Vote of Thanks.

THE PRESIDENT said he thought they had had a very successful evening. Coming to meetings to hear lectures was like paying a visit to a foundry; there was always something to be learnt. He agreed with Mr. Carmichael that in green sand moulding a lot depended upon the touch of the moulder.

A vote of thanks to the lecturer was proposed by MR. EDWARD SMITH, who said that he had listened with great interest to Mr. Brown. All moulders had their difficulties, which they were anxious to overcome, and it was only by meeting together and discussing them that they were able to do so.

In reply, MR. BROWN thanked the members for their appreciation, saying that the object of his Paper had been to arouse discussion, so that the younger members might learn something from it.

Company News.

Bolckow, Vaughan & Company, Limited.—The annual meeting of shareholders was held on October 29, at Manchester, the HON. ROLAND KITSON presiding. In moving the adoption of the report he said:—A large part of the reserve on account of taxation, viz., £112,181, will not be required for taxation liability, but the exact amount cannot yet be determined. The accident and fire insurance and repairs and renewals reserves amount to £237,356, as compared with £216,276 last year. These balances, together with the £429,167 now standing to the credit of the general reserve are employed in the company's business, and form a substantial part of its working capital. In 1917 the board felt that, while large profits were being made at that time, these could not be expected to continue indefinitely. Experience has shown that the iron and steel trades move in cycles of prosperity and adversity. From the year 1917 we began to build up our general reserve, in order to meet the cycle of depression which we knew must come. In 1921 and 1922 our general reserve stood at £1,000,000. In 1923 it was reduced to £500,000 by appropriation to profit and loss, and in the year under review it has been reduced to £429,167 by the writing off of the debit balance on the profit and loss account of £23,332, and by the elimination from the balance-sheet of the £47,500 of underwriting commission. After debiting all standing charges on idle plant we show a profit of £84,677. Now the actual operating profit for the year is £113,316, as compared with £12,245 last year, without taking into account depreciation in either year. By increased employment at our works, and by drastic economies, we have reduced our standing charges on idle plant from £182,131 in 1923 to £23,853 in the present year, and this in spite of the fact that we have been unable to operate our steelworks at more than 50 per cent. of their capacity. To the net profit of £84,677 shown in the balance-sheet we have added £150,000 out of the income-tax reserve. This is a clear surplus which cannot be required. We have thus available, with the amount of £24,816 brought forward from last year, a total sum of £259,493. Out of this we have provided £53,260 to bring our stocks of purchased ore down to their market value, and £18,717 to meet the unwritten-off balance of capital expenditure on the Leasingthorne Coke Ovens. These ovens suffered such severe damage during the prolonged coal strike of 1921 as almost to be destroyed. But for that strike they would have had a working life of some years. Interest charges more than absorb the balance, and the debit of £23,332 has been met out of the general reserve.

Brunner, Mond & Company, Limited.—Interim dividend on ordinary shares, 7 per cent. per annum.

Albion Foundry, Limited, Albion Works, Albion, West Bromwich.—Capital £100 in £1 shares. Directors: W. H. Thursfield and A. Smith.

A. Webster, Limited, 88-90, Chancery Lane, London, W.C.—Capital £10,000 in £1 shares. Metal merchants. Directors: A. Webster and Mrs. L. Webster.

John Brown & Company, Limited.—Interim dividend of 5 per cent. per annum, being 6d. per share on fully-paid ordinary shares and 4½d. on part-paid, less tax.

Watchet Ore Mining, Salvage and Shipbreaking Company, Limited.—Capital £2,000, to acquire from J. Lee, of Watchet, Somerset, interests, etc., conferred on him by a memorandum made between H. Wethercott and J. Lee; to mine iron ore, etc. Permanent directors: W. E. Smith and T. C. Jackson. Solicitor: V. D. De Wet, 22, Castle Street, Dover.

The New Parliament.

Birmingham (Ladywood). — Mr. Arthur Neville Chamberlain is a director of the Birmingham Small Arms Company, Limited, and deputy chairman of Elliot's Metal Company, Limited.

Denbighshire (Wrexham).—Mr. C. P. Williams is the son of the late Mr. Peter Williams, managing director of the Brymbo Steel Company, Limited.

Burnley.—Mr. Arthur Henderson, general secretary of the Ironfounders' Society.

Hampstead.—Mr. George Balfour, the founder and head of the firm of Balfour, Beatty & Company, and a director of several affiliated business undertakings.

Hammersmith (South).—Sir William Bull, a director of Siemens Bros. & Company, Limited, and Siemens Brothers' Dynamo Works, Limited.

Renfrewshire (Western).—Lieut.-Col. A. D. McInnes Shaw is a son of Sir Archibald McInnes Shaw, a former Lord Provost of Glasgow, and of Shaw & McInnes, Limited, Firhill Ironworks, Glasgow.

Richmond.—Sir Newton J. Moore, director of the British Empire Steel Corporation; General Electric Company, Limited.

Book Review.

Kelly's Directory of the Engineering, Iron, Metal and Motor Trades, 1924. Published by Messrs. Kelly's Directories, Limited, 186, Strand, London, W.C.2. Price 45s., post free.

This well-known and much-appreciated directory, which has now reached its sixteenth edition, is designed to provide firms with as complete a list as possible of those engaged in engineering and allied trades. The arrangement adopted has been to divide the book into seven sections. The first is a geographical detailed classification by county. It is followed by an alphabetical trades list. The next sections deal similarly with Ireland. Section V is devoted to a list of proprietary articles and trade names, which number nearly 10,000. Iron and steel sections and brands, with the makers' names and addresses, comprise the last two sections. Altogether there are about 2,475 pages.

Foundry Query.

Moulding Boxes.

Can any reader suggest a plan for the construction of a circular box part, of the sectional type, for the purpose of moulding large pan castings, dry sand? Size of casting (roughly) 6 ft. dia. × 12 in. to 14 in. deep. The box part to be capable of being extended to accommodate a pan of 8 ft. or 9 ft. dia. also.—H.F.

Furnace Heating.—The Department of Fuel Technology of Sheffield University has arranged with Mr. R. J. Sargant, of Hadfields, Limited, to give a course of six lectures on "Furnace Heating."

Trade Talk.

THE STRIKE of rivet-makers at Messrs. Gladstone's works, Stockton-on-Tees, has been settled.

THE FURNIVAL STEEL COMPANY, Sheffield, have leased adjoining premises for extensions to their Furnival Steelworks.

JACKSON'S (SHEET METAL WORKS), LIMITED, Thynne Street, Bolton, will in future be known as Jackson's (Engineers), Limited.

A LICENCE under the Non-Ferrous Metal Industry Act, 1918, has been granted to J. Charkham, Limited, Stour Wharf, Stour Road, Old Ford, London, E.3.

LLOYDS IRONSTONE COMPANY, LIMITED, Princes Chambers, Corporation Street, Birmingham, have removed to Broad Street Chambers, Birmingham.

W. E. MOULSDALE & COMPANY, LIMITED, merchants and metallurgical engineers, of Liverpool, have removed their London offices to Victoria Station House, S.W.

SMITH BROS. & COMPANY (HYSON), LIMITED, valve manufacturers, of Nottingham, have received a repeat order from Vickers, Limited, for valves and deck fittings supplied to the s.s. "Orama," for the sister ship, s.s. "Otranto."

BOLCKOW, VAUGHAN & COMPANY, LIMITED, have just received an order from the Crown agents for the Colonies for steel rails, fishplates, and steel sleepers. The total weight is about 24,000 tons. The materials are required for the Uganda Railways, and will be under the tests and inspection of Rendel, Palmer & Tritton Westminster, London, S.W.

VICKERS, LIMITED, have amalgamated their Australian interests with Commonwealth Steel Products Limited, Waratah, near Newcastle. The new company has been formed for the purpose of an extension of the manufacture of wheels, axles, locomotive steel castings, etc.

W. GILBERTSON & COMPANY, LIMITED, and the Grovesend Steel & Tinplate Company, Limited, have opened a joint sales office at Bush House, Aldwych, London, W.C.2. Mr. A. E. Farmer is in charge. The sale of black sheets for the Japanese market will remain in the hands of the Oriental Steel Company, Limited.

DUNCAN STEWART & COMPANY, LIMITED, Glasgow, are building a large set of up-cutting type billet shears to the order of the Imperial Steel Works, Japan. The shears will be complete with roller rack, stop and measuring gears, and will be electrically driven. It is interesting to note that this order was obtained in world competition.

THE ROYAL INSTITUTE of Scientific Industrial Research of Sweden, a body of similar standing to the Royal Society, has awarded its gold medal of the first class to Dr. Johannes Ruths for his invention of the steam accumulator, which equalises intermittent load exhaust-steam supplies from engines working in conjunction with exhaust steam turbines.

GOODBRAND & COMPANY, LIMITED, Britannia Foundry, Stalybridge, have orders for high-pressure fuel economisers of 1,536 tubes for the new Hartshead Power Station of the Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board, in connection with water-tube boilers working at a pressure of 275 lbs. per sq. inch, and also for a high-pressure economiser for the York St. Flax Spinning Company, Limited, Belfast. The contract has been placed with them by Vickers and International Combustion Engineering, Limited, London, who are installing the first fuel pulverising plant to be used in the district. The latter are in connection with water-tube boilers working at 250 lbs. per sq. inch.

FROM THE CLYDE shipyards the output of tonnage during last month was higher than in any previous October. Four liners account for nearly three-fourths of the tonnage, and one of them had been on the stocks for about a couple of years. Altogether 18 vessels of a total measurement of 84,186 tons were floated during the month. For the ten months the figures are 183 launches, aggregating 459,928 tons, which compare favourably with the 88 launches, totalling 167,000 tons, for the corresponding period of last year. Contrasted with the big output, the tonnage booked since the beginning of the month, although moderately satisfactory, is a long way short of counterbalancing. Among the orders reported are: Wm. Denny & Bros., Dumbarton—a motor ship of 8,000 tons; A. M'Millan & Sons, Dumbarton—a motor cargo vessel; Clyde Shipbuilding & Engineering Company, Port Glasgow—two steamers of 8,000 tons each for Trieste owners; Lithgows, Port-Glasgow—two steamers, each of 5,500 tons deadweight, for H. Hogarth & Sons, Glasgow; Napier & Miller, Old Kilpatrick—steamer of 2,500 tons deadweight for the Eastern Steamship Company, Canada; Greenock Dockyard Company—steamer of 5,000 tons gross for Barr, Crombie & Company, Glasgow; and Fleming & Ferguson, Paisley—a dredger for the Queensland Government.

Obituary.

MR. O. NETTLEFOLD, of Elmore's Metal Company, Limited, Finsbury House, Blomfield Street, London, E.C.2, died recently at the age of 60.

MR. J. W. EARLE, founder and ex-chairman of the Cold Rolled Brass Association, Birmingham, died on November 4, aged 57.

MR. M. WADSWORTH, of Oak Bank, Ripponden, near Halifax, managing director of Jerry Wadsworth & Son, Limited, engineers, Ripponden, died last week.

MR. S. DUCKENFIELD, who died last week, was a valued employé of John Henry Andrew & Company, Limited, Toledo Steel Works, Sheffield. Mr. Duckenfield, who was 62 years of age, had been employed by Messrs. Andrew & Company for 48 years. His father was manager of the crucible melting department when Mr. Duckenfield started, and the latter held the same post at the time of his death.

Personal.

MR. C. WILLIAMS, of Portmadoc, North Wales, foundry manager, has been placed on the Commission of the Peace for Carnarvonshire.

MR. A. A. JONES, the president-elect of the Institution of Heating and Ventilating Engineers, is associated with the Central Heating Company, Limited, of Denman Street, London, S.E.1, which recently incorporated J. F. Phillips & Son, Limited.

MR. G. A. V. RUSSELL, who for the last four years has been works manager of the new Darnall Works of Davy Bros., Limited, and was responsible for their starting up and organisation, has resigned his position and is now making an extensive tour of the steel districts of France, Belgium, Germany and Luxembourg, to study the latest Continental developments in steel-making and rolling-mill practice.

Wills.

HERBERT, G. H., iron and metal merchant, Loons Road, Dundee	£5,089
BRIDDEN, J., of Oxford Street, Sheffield, late of Leadbeater & Scott	£7926
NOON, H., formerly secretary of the Rotherham Forge and Rolling Mills	£4,450
HOLDING, J., of Sheffield, chairman of John Holding & Company, Limited, steel forgers and manufacturers	£12,801

Contracts Open.

Feltham, November 22.—Iron railings and gates, for the Feltham Urban District Council. Mr. H. W. A. Carter, surveyor.

Bristol, November 15.—Stores, for the Sanitary and Improvement Committee. The City Engineer, 63, Queen Square, Bristol. (Fee, 10s., returnable.)

London, S.E., November 20-25.—The Director-General, India Store Department, Branch No. 14, Belvedere Road, Lambeth, S.E.1, requires steam road rollers.

Bristol, December 1.—Three 9-ton steam cranes for grabbing, for the Docks Committee. Mr. T. A. Peace, chief engineer, Avonmouth Dock, Bristol. (Fee, £5, returnable.)

Buenos Aires, Argentina, December 22.—Two sets of vertical shaft centrifugal pumps operated by electric motors, for the Argentine National Sanitation Works. The Department of Overseas Trade, 35, Old Queen Street, S.W.1.

Buenos Aires, December 22.—The Argentine National Sanitation Works Administration require two sets of vertical-shaft centrifugal pumps operated by electric motors. The Department of Overseas Trade, 35, Old Queen Street, S.W.1. (Reference A.X.1432.)

Loughborough, Leics., November 18.—Providing, carting, excavating for and laying about 790 lineal yards of 6-in. cast-iron and other mains, etc., for the Corporation, Mr. A. H. Walker, waterworks engineer, Town Hall, Loughborough. (Fee, £3 3s., returnable.)

London, S.W., November 14-January 2.—Stores, for the South Indian Railway Company, Limited, viz.:—Locks, galvanised sheets, steel work for bridges (Ferok and Kallayi), bogie steel ballast wagons. The Company's Offices, 91, Petty France, Westminster, S.W.1. (Fees, 2s. 6d., 5s., 10s., and 20s., non-returnable.)

MESSRS. A. F. JELLYMAN, H. JELLYMAN and E. JELLYMAN, Cannock Foundry & Engineering Works, Cannock, trading under the style of Samuel Jellyman, have dissolved partnership. Mr. A. F. Jellyman will continue the business under the same style.

MACNAB & Co.

TABOR MOULDING MACHINES (TABOR PATENTS)

For Every Class of Work.

Pit Type and Portable Combination Shockless Jar Ramming Power Roll-over and Pattern Drawing Machines; Power Squeezing and Jar Squeezing Machines; Shockless Jarring Machines, etc., etc.

SPECIAL FEATURES AND ADVANTAGES:

Accurate Definite Draw with Permanent Accurate Alignment.

All Operations Controlled by One Lever.

Uniformity in size of Castings produced.

All Moulds squeezed alike to whatever Pressure Required.

Minimum Percentage of Wasters.

The above illustrates the TABOR POWER SQUEEZING "SPLIT PATTERN" MOULDING MACHINE, specially suitable for all small patterns which can be split in halves or for flat back Work.

A customer writes—

"The Machines draw perfectly in producing deep castings with the minimum amount of taper, and we are fully satisfied with them, as they are most economical in use and give the maximum production."

Capacities and Dimensions furnished upon application:

56/8, Eagle Street, Southampton Row, London, W.C.1.

Works: TOTTENHAM, LONDON, N.17.

IRON AND STEEL MARKETS.

Pig-iron.

MIDDLESBROUGH.—Following the recent improvement in the political outlook, the Cleveland iron market has promptly developed a more active tone, with the values of No. 3 G.M.B. distinctly stronger, while there is also a most encouraging increase of demand on home account and a better inclination to purchase for forward dates. Prospects in the export section of the market may also be regarded as more favourable, the shipments of pig-iron from the port of Middlesbrough and Skinningrove during October having amounted to 44,877 tons, as compared with 31,989 tons in September, an increase of 12,868 tons. Business in the Tees-side market this week was done at the advanced quotation of 82s. per ton for prompt delivery, with No. 1 at 87s., No. 4 foundry 81s., and No. 4 forge 80s. per ton.

Similar active conditions were also experienced in the hematite market, a brisk business passing both for home consumption and for export, while stocks during the last week or so have been substantially diminished. Prices, however, are firmer, East Coast mixed numbers being quoted at 88s. 6d., with 1s. per ton more for No. 1. In the North-West area, though some slight improvement is impending, prices are unaltered, Bessemer mixed numbers being still quoted 100s. per ton delivered at Glasgow, 102s. 6d. per ton delivered at Sheffield, and 106s. per ton delivered at Birmingham.

LANCASHIRE.—Though slower in responding to the generally hopeful attitude of the trade, the market for foundry iron at Manchester has also participated to some extent in the improvement now in progress, and in many cases sellers seem inclined to hold for firmer rates. Some Midland furnace agents report that the stream of inquiries is continuous, and as a result, in many cases, sellers now decline to accept any further orders unless at an advanced price. Whether this is the beginning of a steady improvement in foundry iron prices it would be difficult to say, but it is true that many of the Derbyshire furnaces which were selling freely on a basis of 80s. per ton on trucks are now asking 82s. 6d.

THE MIDLANDS.—In South Staffordshire and the adjacent districts the outlook for foundry iron is also regarded as more encouraging than of late, with values inclined to stiffen, a slight advance having been reported. Quotations now ruling are as follow:—Derbyshire No. 3 foundry, 81s. to 82s. 6d.; Staffordshire No. 3 foundry, 85s.; Northants No. 3 foundry, 75s. to 77s.

SCOTLAND.—Although buyers of foundry iron in the Scottish markets are still proceeding on cautious lines, there is a distinctly firmer tone observable, and for actual business makers are adhering more closely to the nominal price of 90s. per ton for No. 3 at the furnaces, and, in fact, in some cases 91s. to 92s. 6d. is being asked. This improvement has been brought about through an inclination on the part of home consumers to make purchases.

Scrap.

The improvement noted in other markets for raw material is also gradually extending to the scrap trade, in which inquiries are rather more numerous, with dealers inclined to stiffen the very low prices now ruling. In Lancashire the cast-scrap market is a little firmer on the reports that a good deal of buying of foundry pig-iron has taken place since the result of the election was announced. Dealers at Manchester are not now offering any cast scrap at less than 80s. per ton, and for special lots, such as broken textile machinery iron, some sellers ask 85s. The feature in the Scottish market has been the strong inquiry for machinery cast-iron scrap, which has certainly improved in demand. Cast-iron borings are still plentiful, and difficulty is being found in finding an outlet at 40s. to 41s. 3d. per ton. Machinery cast-iron scrap has improved of late, with a better demand, and 87s. to 90s. is now being quoted. Some small parcels have changed hands at these figures.

Metals.

Copper.—Election results, both at home and in the United States, have had a favourable effect upon standard metal, while increasing improvement in the stability of the Continental position is a further strengthening factor in this market. Already confidence is returning in commercial and financial circles, and there is now every probability of a period of quietly steady trade before the close of the year. The orders put through for electrolytic have been secured by large dealers, whose competition so far has continued rather keen, but prices have advanced again. Current quotations:—*Cash*: Thursday, £63 12s. 6d.; Friday, £63 7s. 6d.; Monday, £63 10s.; Tuesday, £63 15s.; Wednesday, £64.

Three Months: Thursday, £64 15s.; Friday, £64 10s.; Monday, £64 12s. 6d.; Tuesday, £64 15s.; Wednesday, £65 2s. 6d.

Tin.—Movements in the standard tin market have continued steadily favourable, influenced largely by the encouraging nature of the October statistics, disclosing a decrease in visible supplies of 1,500 tons for the month. This has stimulated the hope that the last of the pooled stocks are being marketed. The official agency has not received any further news, but it is obvious that all this tin is not coming out of current production. The American demand has been a helpful factor, and may do even better in the near future. Current quotations:—*Cash*: Thursday, £256 15s.; Friday, £257 15s.; Monday, £258 5s.; Tuesday, £258 15s.; Wednesday, £259 2s. 6d.

Three Months: Thursday, £259 15s.; Friday, £260 5s.; Monday, £261 5s.; Tuesday, £261 15s.; Wednesday, £262 7s. 6d.

Spelter.—Business in this section of the market has certainly improved, and recent movements have been towards a higher plane. Undoubtedly the 10 per cent. reduction in the American stocks is acting as a bullish factor, although there are others. The Belgian producers are well sold up, and Germany is still buying Belgian metal. Current quotations:—*Ordinary*: Thursday, £34 10s.; Friday, £34 12s. 6d.; Monday, £34 15s.; Tuesday, £34 18s. 9d.; Wednesday, £35 2s. 6d.

Lead.—The market for soft foreign pig continues strong, with the bullish element still predominant. The anticipated contraction in this month's arrivals was a helping factor in conjunction with strong American reports indicating increased domestic requirements. Values here may be further inflated, but views as to future developments are conflicting. Germany may be speculatively over-bought, and this may lead to resales. Current quotations:—*Soft foreign (prompt)*: Thursday, £39 5s.; Friday, £38 12s. 6d.; Monday, £39 5s.; Tuesday, £39 7s. 6d.; Wednesday, £39 10s.

COLTNESS IRON CO., LTD.

Makers of the well-known and old-established

"COLTNESS" BRAND OF HIGH CLASS SCOTCH PIG IRON

FOUNDRY. No. 1, No. 3, No. 4. | STANDARD GRADES | HEMATITE. No. 1, No. 3, No. 4.

Works:— Newmains, Lanarkshire.

PRICES, ANALYSES, ETC., MAY BE OBTAINED ON APPLICATION TO THE GLASGOW OFFICE.

Office: 138, West George St., Glasgow.